THE COMPLETE PHOTOGRAPHER

39225

A Complete Guide To Amateur And Professional Photography

WILLARD D. MORGAN, GENERAL EDITOR

VOLUME SIX

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FOREWORD

RESEARCHERS, chemists, and inventors took millions of exposures during the perfection of the photographic process. Such tests helped to produce better and faster emulsions, served to discover exposure characteristics, and revealed the general behavior of new photographic products. While men played a dominant position in the first century of photography, when it took muscle or possibly a horse and buggy to carry a complete camera outfit, this balance is rapidly being upset today with the invasion of women into the challenging field of photography. These newcomers bring fresh viewpoints, try the supposedly impossible with photo emulsions and create significant, stimulating pictures. There is a fresh creative spirit surging up in this field which finds a genesis in the woman photographer.

Right now we are becoming familiar with many women photographers, such as Berenice Abbott, Margaret Bourke-White, Doris Day, Toni Frissel, Laura Gilpin, Lotte Jacobi, Dorothea Lange, Nina Leen, Mary Morris, Hansel Mieth, Barbara Morgan, Ruth Nichols, Helen Post, Carolyn Ramsey, Carola Rust, Madeline O'Reilly, Pat Liveright, Mildred Hatry, Lisette Model, Ruth Bernhard, Judith Webster, Elizabeth Hibbs, Iris Woolcock, Mary Eleanor Browning, Dorothy Gale, Helen Honeywell, Dorothy Wilding, Marion Post Wolcott, Ylla, and many others. Then there are hundreds of other women who are finding very important jobs in photographic laboratories, finishing departments, medical departments, and also in photographic factories, and behind photographic dealer counters. All these fields are due for continual expansion just as rapidly as new photographic products appear. The war diverted many products into the military service. But with the coming of peace all these new products are available for public use. Right now is where the big change is coming. I want to urge many women who are looking around for an interesting hobby or a regular profession to investigate the photographic field.

Today, with light equipment and convenient processing methods, there is no reason to think that a woman is extraordinary because she is a photographer or that a photographer is unusual just because she is a woman. The novelty of this is passed, and we are now all interested in working together for the mutual advancement of our photographic interests. In some fields of photography—feature news work, and child photography, for instance—women have a distinct advantage. Women like Jackie Martin, Harriet Patnick, and Marion Strahl are engaged in active spot news photography and the number who contribute to features (either regularly or in a free lance capacity) is great. Mary Morris does fine work for *PM* Newspaper, Hansel Mieth's work for *Life* is outstanding, and Nina Leen is a constant contributor to *Look, Spot,* and *Life.*

Others should be included—important among these is Margaret Bourke-White, who helped to bring industrial photography out of its matter-of-fact recording stage. Her work has appeared in many publications including *Fortune, Life,* and numerous books. Then Berenice Abbott, Dorothea Lange, and Marion Post Wolcott are a trio making important contributions in the documentary field. In fashion photography, the names of Louise Dahl-Wolfe and Toni Frissel are on top. Barbara Morgan has become internationally recognized for her dance photography and other work revealing an intuitive interpretation of action. Ruth Nichols is tops in the photography of children, while Florence Vandamm turned her talents to theater photography. Ylla has won fame through her animal pictures, Dorothy Wilding and Lotte Jacobi in portraiture, and Carola Rust in commercial and illustrative photography. In allied photographic fields there is Katherine Blodgett who was one of the first scientists to experiment with lens coatings, and Adelaide Easley who is doing such important research in the photo lamp laboratory at General Electric.

First of all, let us investigate the field of photography just as an interesting avocation or hobby for the woman photographer. It is within the scope of every woman to learn the elementary principles of photography. This can be done right in her own home, making it unnecessary to interrupt the management of the home. A few hours can be devoted every week to the study and practice of photography. She can photograph her own family, the neighbors, or go farther afield and obtain interesting compositions within her own town. She will find that her photographic interests will bring her in contact with other men and women workers. It is an interest which can always be added to when new fields are explored.

The more serious worker will undoubtedly want to know how she can obtain a basic photographic training which can be used for pleasure or for profit. To start with there are always some

photographic friends who will give plenty of advice from the start. Then the next step is to attend a local camera club, if there is one in your locality. If this is not feasible, you can always find stimulating information from photographic magazines and books. Still another step is to attend a photographic school or subscribe to a special photographic course. After all this you will find that the real experiences and ideas will come when you yourself start taking pictures. The more you work with the camera and observe the results, the more you will be able to evaluate your own work. As you learn to look for good picture subjects, you will become more discriminating in your ability to see things about you. If you have any art training, it will help in making better compositions and also in making the final print where it is necessary to leave out non-essentials in the picture.

All of your reading, observations, and discussions with other people can be a source for creative photographic ideas. You may see an unusual flower arrangement in the home of a friend—photograph this with your camera. Someone else may talk about some interesting experiences at a local fair or exhibit. Here again your camera can come into quick action. Nearby there must be interesting events taking place. You can take close-ups of children playing, animals, interesting character studies, mountain scenes, or interesting composition arrangements which can be set up in your own home. I am sure that the great majority of new women photographers will take up this hobby simply for the pleasure and recreation which it gives. Right here is where your interest will become keener. You may start specializing in some particular field, with the result that your work will become better known and possibly develop a market for the sale of some of your pictures. After all, there is nothing like the first thrill of seeing your first photographs published.

If you are primarily interested in getting into photography as a profession, then the procedure will be different. First of all, visit the studios of local commercial photographers. Also talk to one or two local news photographers. Then investigate a nearby photographic school. Ask lots of questions. You will find that photographers are always ready to give good advice. You will get many conflicting answers. However, out of all this you will have something to work on and guide you in making your final decisions. If you are attending a high school or a university, the chances are that there will be photographic courses available; otherwise, you can carry on your photographic studies along with your school work. In many cities there are excellent night schools where photography can be learned. Then, there is a photographic correspondence school, such as the New York Institute of Photography, always available. If you can get a position as assistant or apprentice with some local photographer, this would undoubtedly be the ideal way to start. Then carry on your special studies along with practical work. At the present time there are very few full-time photographic schools. If you have the time and money, it would be advisable to enroll in one of these institutions, such as the Art Center School in Los Angeles, the Mechanics Institute in Rochester, New York, or the New York Institute of Photography, New York City. There are other schools in other parts of the country worth investigating.

There are so many interesting photographic subjects to be covered, that the trained woman photographer can easily make a name for herself. Any woman going into commercial or professional photography should not get the idea that she will be a famous photographer overnight. This is the exception rather than a rule. After all, it is a commendable achievement to be well known in your local community as an outstanding photographer. This may be in the photography of children, in the commercial field, or possibly work in industrial plants.

Then, there is always a fascinating field for the free lance woman photographer. Here is where it is possible to make photographs of practically anything which may have a publication interest. The important thing is to do good quality work and photograph significant subjects. To do this, you only have to turn to the picture magazines of any publication which uses photographs and make a thorough study of the illustrations. You can start out in the free lance field by making a few photographs each week, and at the same time carry on your school work or your work in any business or in the home. Let photography go through its own gradual growth as you become more proficient in this field. The day may come when you can devote full time to your photographic work if you wish. An artist, a doctor, or any professional worker takes years to study his profession. The same should be true with photography. If you really want to get to the top in this field, you must go through some good tough apprenticeship years of training.

WILLARD D. MORGAN.

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HIGH SPEED PHOTOGRAPHY
(continued)

In Figure 3 the voltage axis shows voltages squared as equal increments. The graphs of this variable against relative intensity are not the straight lines which might be expected from simple theory. Neither is this true of the graphs in Figure 4 which show relative intensity as a function of capacity.

Different photographic materials behave in different ways in regard to the photographic effects produced by variation in the lamp driver circuit. All exhibit a somewhat lower contrast than is usual with ordinary camera exposures.

TIME FACTORS

The time which is taken by the electrical energy to drain out of the condenser and through the lamp, depends on the capacity of the condenser and the resistance of the electrical circuit including the lamp. This relationship is stated:

$$t = CR$$

If the capacity unit is in farads and the resistance in ohms, the time of the lamp flash will be given in seconds. Thus it would take a one-farad condenser one second to discharge through a lamp whose resistance was one ohm. The farad is so huge a unit of capacity that a commercial one-farad condenser would fill a large room and would weigh several hundred tons. The unit of capacity which is used practically is one millionth of a farad—one microfarad.

For a rough approximation of the time of flashing of a condenser discharge lamp, the lamp resistance may be assumed to be one ohm. The time of the flash then—in millionths of a second (microseconds)—is about equal to the number of microfarads of condenser capacity.

Actual experiment shows that this way of reckoning the flash time is fairly accurate for circuits in which the capacity is greater than 30 microfarads, but that the effective resistance of the lamp must be in excess of one ohm when smaller condensers are used.

Some traces of intensity vs. time for different condensers are shown in Figure 5. The data for these traces were obtained by photographic photometry computation, using a special camera in which a band of sensitive film wound around a wheel was whirled at high speed past a slit illuminated by the lamp flash. Analysis of the traces shows that with a 4-microfarad condenser the intensity reaches a relative value of 229 in 2 microseconds and decreases to one-tenth of this peak value in 29 microseconds. The 32-microfarad flash decreases to one-tenth its peak intensity in 66 microseconds. Similarly the 64 and 128 microfarad flashes drop to one-tenth their peak intensity in 82 and 125 microseconds respectively.

THE TRIGGER

Human perceptions are not keen enough to follow motion much more rapid than 20 or 30 cycles per second. With rapid motion which the discharge lamp is capable of stop-

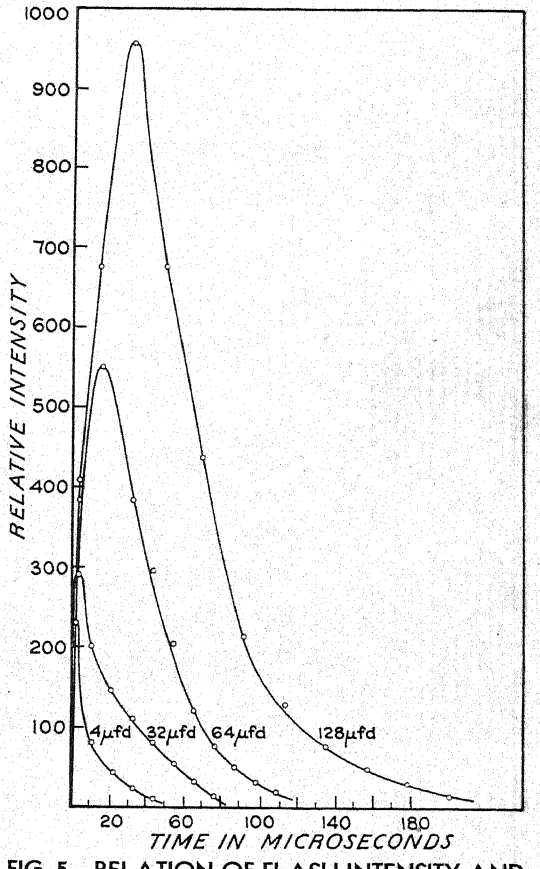


FIG. 5. RELATION OF FLASH INTENSITY AND TIME. Shown at various capacities

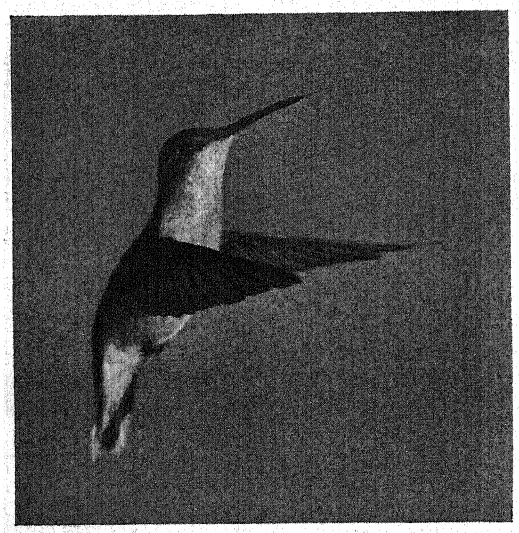


FIG. 6. HUMMING BIRD. 1/100,000 second flash synchronized by contact on shutter mechanism
Photo, Harold E. Edgerton

ping, it would be impossible in most cases for a person to know when to open the shutter and flash the lamp. Electrical and mechanical means are often used in circuits which make it possible to fire the lamp at the exact time desired.

The strobotron trigger circuit which is pictured in the lower part of Figure 2 may be actuated by many kinds of tripping devices. R_3 and R_4 are grid bias resistors for the inner grid of the strobotron and determine the voltage on the control grid necessary to cause the tube to conduct. When S_2 is closed, the control grid is made more positive, the tube conducts, and a single pulse through C_5 and C_6 to the spark coil causes the lamp to fire. The lag between the closing of the switch and the firing of the lamp is negligible, so that precise synchronization by various methods is possible.

Synchronization. The mechanical action of camera shutters can be made to close S_2 at the moment when the shutter blades are fully open. By sighting through the shutter at the lamp the synchronization can be easily checked. This method is perhaps the simplest and most generally useful. It is adaptable to many kinds of pictures where the motion is rapid and it is impractical to set the shutter at "open" and trip the lamp circuit by hand. Figure 6 of a humming bird hovering in mid-air is an example of this type of synchronization. The shutter synchronizer made possible other lights on the subject up to and during the exposure. The intensity from these lights, however, was negligible in comparison to that from the gas discharge.

Portraits lend themselves to hand synchronization. After the lighting is arranged, the photographer opens the shutter, in a dim light waits for the expression he wishes, and trips the lamp circuit. The subject is relaxed,



FIG. 7. PISTOL SHOT. 1/1,000,000 second flash synchronized with action set up by sound waves striking the microphone
Photo, Edgerton, Germeshausen, and Grier

there are no bright lights to cause wrinkles around the eyes, and the pupils are large.

SUBJECT POSSIBILITIES

In commercial photography many subjects which are not ordinarily thought of as having any high speed requirements are difficult to immobilize for exposures lasting even a fraction of a second. Fine textured fabrics, small print on rustling paper sheets, hair on a model's head may move enough during the ordinary exposure time to cause blurring of detail. With flash exposures of a tenth of a thousandth (1/10,000 second) or shorter duration, even fine texture moving in a breeze is frozen.

Another kind of subject usually regarded as requiring the very reverse of high speed photography can also be neatly handled with the aid of these gaseous discharge lamps. Studies of growing plants are often made with the aid of time-lapse motion pictures—pictures made one at a time at hourly intervals and run together. The taking of such pictures of plants in their natural environment is made difficult because of continually changing lighting conditions. The intensity available in a condenser discharge flash may be made so much greater than that of any natural light present that presence or absence of the latter may be disregarded. Synchronization of the motion picture camera shutter with the tripping circuit of the lamp and, of course, with a timing mechanism, will produce a series of pictures each of very short exposure completely unblurred but spaced by the desired time interval.

RAPIDLY MOVING SUBJECTS

Sound Wave Control. Rapidly moving subjects may be caught at the precise moment desired by any one of several methods, depending on the character of the motion. Three methods, on which there are many variations, serve for the synchronization of ultra rapid motion and exposure. When an impact causing a sound occurs at the right moment, a microphone feeding through an amplifier may be used to close S_2 and fire the lamp. Figure 7 is an outstanding example of this synchronization method. A microphone held in front of the pistol muzzle tripped the lamp at the right moment to catch the discharge gases as they pushed the bullet from the gun.

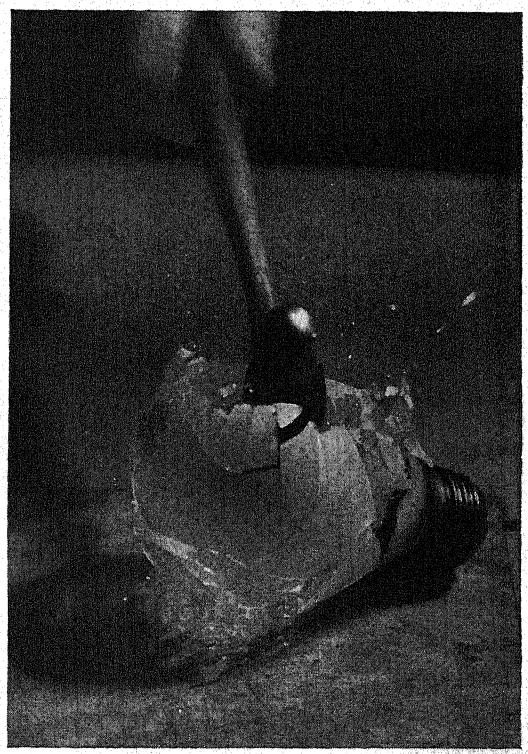


FIG. 8. LAMP BREAKING. Flash synchronized by contact trip operated by the breaking lamp bulb
Photo, Harold E. Edgerton

Control by contact offers another synchronization method. In Figure 8 the breaking of the bulb was made to close the firing switch mechanically.

Photoelectric Control. Photoelectric control of a lamp-tripping circuit is often used when a sequence of events makes no noise or can make no contact at the precise moment when a picture is desired. Figure 9, showing a golf ball approximately 1/1000 second after leaving the club head, was taken when the golf ball crossed between a photocell and light source. Photocell control may also be used to trip one flashing lamp from another, with practically no lag between them.

Multiple Flash. Multiple flash pictures on one piece of film are very useful in the study of acceleration and velocity of non-uniform motion, such as a golf or tennis swing. The tripping switch is replaced by a commutator which may give flashing frequencies from a few to several hundred per second. Figure 10

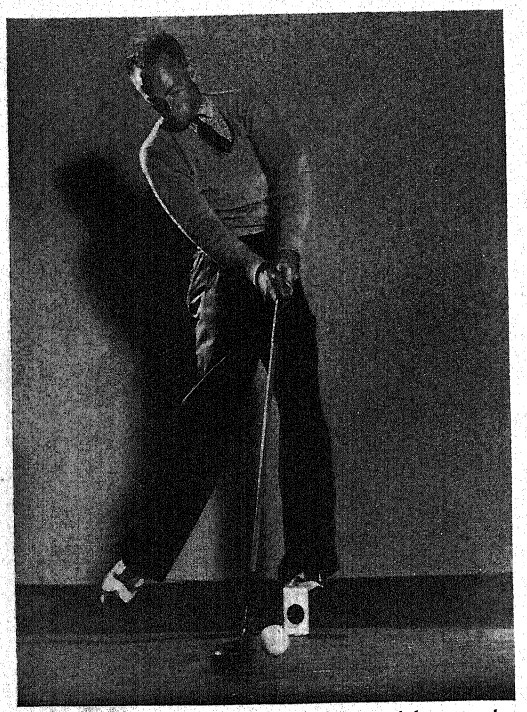


FIG. 9. GOLFER. Flash synchronized by impulse from a photoelectric cell as the ball crosses a light beam

(see page 25) shows a golfer's swing taken with a lamp flashing 100 times per second. Knowing the scale, both the ball and club velocity can easily be found.

IN MOTION PICTURE PHOTOGRAPHY

In conventional high speed motion picture photography it is impractical to attempt intermittent film travel at speeds higher than about 200 frames per second. Speeds higher than this necessitate continuous film travel with an optical system of some kind which moves the image in the same direction as the film travel, and at the same speed. Cameras of this type have been made to take several thousand pictures a second.[8,9] The condenser-discharge lamp, however, makes possible high speed motion pictures with continuous film travel and a stationary optical system. A commutator fastened to the film drive shaft spaces the lamp flashes exactly one frame apart, and the exposure is so short that there is no blur at film speeds of 125 feet or 2000 frames per second and higher.

[8]Tuttle, F. E., "A Non-intermittent High Speed 16 mm. Camera," *Journal of the Society of Motion Picture Engineers*, 21: 474-477 (1933).

[9]Jenkins, C. F., "The Jenkins Chronoteine Camera for High Speed Motion Studies," *Transactions of the Society of Motion Picture Engineers*, 25: 25-30 (1926).

KODATRON SPEEDLAMP

A compact condenser-discharge lamp unit, designed by Dr. Edgerton, is available from the Eastman Kodak Company under the name Kodatron Speedlamp. The circuit of this unit is similar to that of Figure 2. The main condenser, C_2, has a capacity of 112 microfarads and is charged to 1850 volts. The lamp used (see Figure 11) is spiral in shape, about two inches in diameter, and has an arc length of 18 inches. A tungsten pilot lamp in the center of the spiral serves as a modeling light. The pilot and tube are mounted on a large five-prong plug and enclosed in a glass

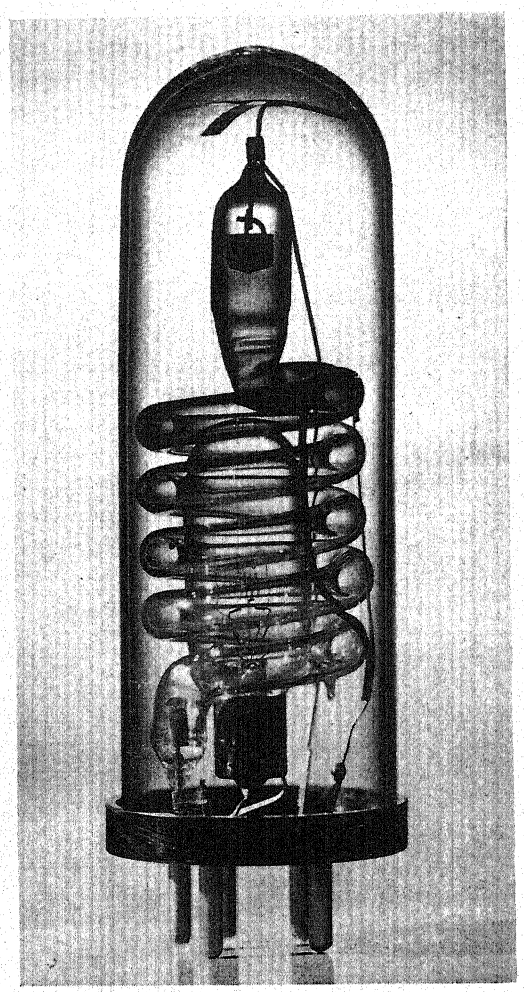


FIG. 11. KODATRON SPEEDLAMP. A spiral of tubing surrounding the pilot lamp—both enclosed by a protective glass envelope

envelope. The lamp is held in a large reflector mounted directly on the power supply. Each bulb is good for 10,000 or more flashes.

The radiation from this lamp, which is filled with a krypton-xenon mixture, is rich in blue, with some red and infrared and somewhat less green. Emulsions exposed to the speedlamp, due to their reciprocity failure at low exposure times, exhibit both a gamma loss and a lengthening of the toe

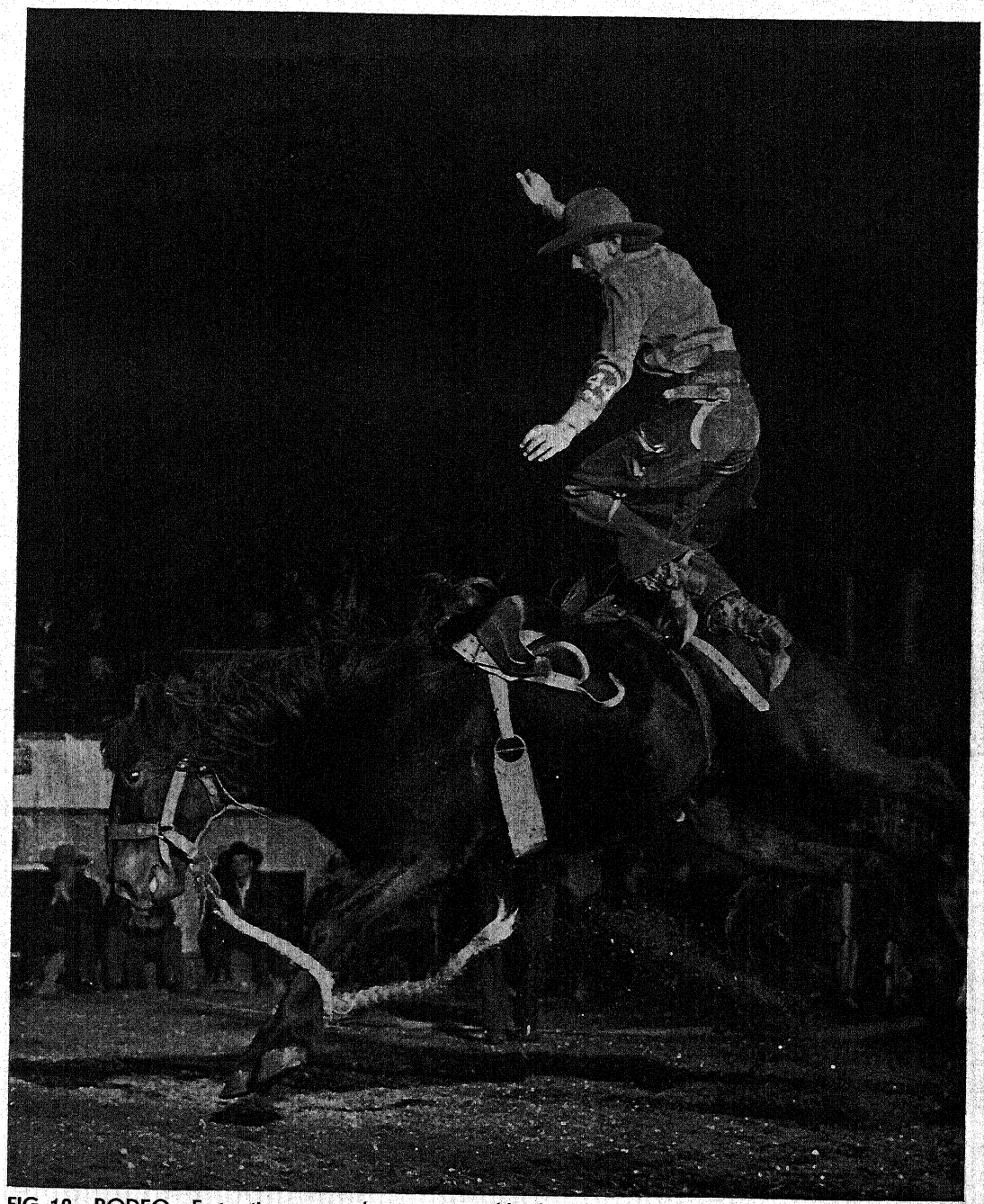


FIG. 12. RODEO. Fast action news and sports pictures like this one are possible with high speed photography exposed at 1/10,000 second
Photo, Harold E. Edgerton

portion of the characteristic curve. Listed in the table below are exposure values for use with *one lamp in a reflector 10 feet from the object.*

	Aperture	Development DK-50, 65° F.
Tri-X Panchromatic	f/56	14 minutes
Ortho X	f/64	11 minutes
Verichrome	f/48	15 minutes

The above development times are nearly twice the recommended values for tungsten exposures. This is desirable in order to bring the average gradient up to the value which is regarded as standard. A special emulsion called Kodatron Panchromatic film has been made for the lamp. This has a higher development rate and more nearly normal development time.

Though none of the gaseous mixtures so far used in these lamps will give light of the exact color of daylight or of tungsten sources, filters have been worked out which make it possible to get excellent color reproduction with either daylight or artificial-light Kodachrome. Some beautiful examples of colored action pictures, the work of Gjon Mili, were recently reproduced in *Life.*[10]

The Speedlamp is continually finding broader fields of usefulness in scientific, news (Fig. 12), educational, and pictorial photography. The extremely high intensity and the brief exposure period have so many advantages and so few disadvantages that it will not be surprising to see a gradual replacement of other conventional light sources in many situations.

[10]Mili, Gjon, "Gjon Mili Photographs Ballet Dancers at High Speed," *Life*, Vol. 8, No. 8, February 19, 1940.

DAVID OCTAVIUS HILL

Dr. Heinrich Schwarz

Author of David Octavius Hill *and other books; Albright Art Gallery, Buffalo*

D. O. Hill, photographer of the 19th century, is particularly famous for his portraits, and the pictures which he and Robert Adamson made are said to surpass any others produced by the calotype process. Here is an authentic account of Hill's life and work.

See also Calotype, History of Photography

BORN IN Perth, Scotland, 1802. Died in Edinburgh, 1870.

Painter, lithographer, and photographer. After a scanty artistic education in his native town, Hill moved to Edinburgh about 1822. There he studied landscape painting under Andrew Wilson at the old Academy. At an exhibition in Edinburgh in 1823, he first showed one of his paintings. However, his productivity as a landscape painter never surpassed the limits of a very mediocre artistic talent. From 1830 to 1869 Hill held the office of Secretary of the Scottish Academy of Painting, Sculpture and Architecture.

Shortly after the publication of the Calotype (Talbotype) Process (March 1839), invented by Henry Fox Talbot, as early as 1840, Hill like many other contemporary painters and engravers turned his attention to photography. His intensive photographic activity, however, did not start before the spring of 1843. Encouraged by Lord Henry Cockburn, Hill decided at that time to immortalize in a great painting the memorable occurrence of the founding of the Free Church of Scotland which took place in Edinburgh May 18th-23rd, 1843. The rather poor painting representing the memorable Act of Separation and the Deed of Demission, which unites about 470 portraits of members of the assembly, was begun in September 1843, but was not finished until 1866. In that year it was shown at several exhibitions in Scottish and English cities. It is now hung in the Assembly Hall of the Free Church of Scotland, Edinburgh.

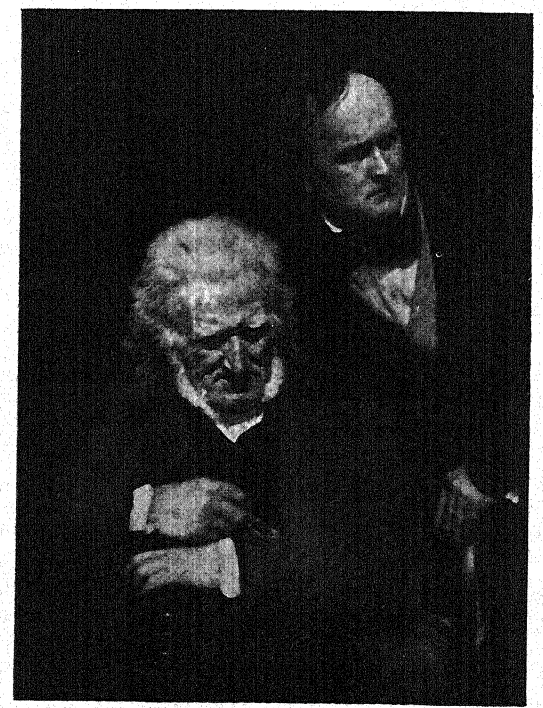
In order to obtain portraits of the numerous participants in this ecclesiastical meeting, many of whom were in Edinburgh for only a short time, Hill decided to use the help of photography with which he had been familiar for almost three years. However, he did not feel himself equal to this huge task and seems to have asked Sir David Brewster, Professor of Physics and Principal of the University of St. Andrews (1838-1859), for an assistant and collaborator. Brewster had been in personal contact with Fox Talbot since 1831 and had visited the inventor at his country seat, Lacock Abbey in 1836. There he had become acquainted with the latter's photographic experiments at a very early stage. In 1839 Talbot seems to have informed David Brewster of his successful invention. Brewster recommended to Hill his fellow-countryman, Robert Adamson (born in Burneside, 1821; died in St. Andrews, 1848). He was the

younger brother of Dr. John Adamson (1810-1870), a St. Andrews medical practitioner, who had devoted his attention to photography at a very early date, and had produced the first Calotype portrait in May, 1840 (Coll. Dr. R. O. Adamson, Glasgow). Between 1843, the year of Hill's removal to the Rock House studio, at the foot of Calton Hill, Edinburgh, and 1847, when Robert Adamson left him to return to St. Andrews, Hill and Adamson collaborated on several hundred photographic portraits. A great number of them were preliminary "portrait studies" for the Free Church painting in which they can oftentimes be found almost exactly copied. In addition to these "studies," Hill and Adamson made many photographic portraits and group portraits of their friends, of members of the aristocratic and fashionable Scottish society, and of outstanding visitors in Edinburgh, thus creating a unique Scottish and English portrait gallery of the early Victorian period. They also did genre



LORD COCKBURN, FAMILY, AND FRIENDS. Here is an example of Hill and Adamson's group work. From a contemporary print
From the Collection of Heinrich Schwarz

pictures, landscapes, views of various towns, monuments in Edinburgh (Greyfriars' Churchyard, Scott Monument), and other Scottish cities, especially Newhaven and St. Andrews. In fact Hill's first calotypes, made between 1840 and 1843, were generally architectural scenes. In 1846, one year after Fox Talbot had published his album of calotypes, "Sun Pictures in Scotland," Hill and Adamson edited "A Series of Calotype Views of St. Andrews" (21 Calotype plates, plus one Calotype vignette).



JOHN HENNING AND ALEXANDER HANDYSIDE RITCHIE. Henning (left) was a sculptor known for his reduced copies of the Parthenon frieze; Ritchie, also a sculptor, was an Associate of the Royal Scottish Academy. From a contemporary print by Hill and Adamson
From the Collection of Heinrich Schwarz

The Calotypes by Hill and Adamson surpass in quality all other pictures produced by this process which was soon to be displaced by the collodion process, invented in 1851. By virtue of their artistic conception and their personal character they are regarded as the most precious documents ever created by photographic means. Whereas the Daguerreotype portraits attempted to create the artistic impression of miniature paintings, Hill's and Adamson's calotypes were chiefly influenced by the English mezzotints and their models, the masterworks of the great English and Scotch portrait painters of the 18th and early 19th centuries. "There is the same broad freedom of touch; no nice miniature stipplings, as if laid in by the point of a needle—no sharp-edged strokes; all is solid, massy, broad; more distinct at a distance than when viewed near at hand. The arrangement of the lights and shadows seems rather the result of a happy haste, in which half the effect was produced by design, half by accident, than of great labor and care; and yet how exquisite the general aspect. Every



MRS. ANNA BROWNELL JAMESON. Besides doing studies for the group of the Scottish Church Assembly, Hill and Adamson took many portraits of friends and famous visitors to Edinburgh

stroke tells and serves, as the portraits of Raeburn, to do more than to relieve the features: it serves also to indicate the prevailing mood and predominant power to the mind." (Hugh Miller).

Hill and Adamson used a camera constructed under Brewster's immediate direction ("Comptes rendus hebdomadaire des sciences de l'académie des sciences," XIX, 1844, pp. 489 to 499). Their lens was an ordinary Petzval portrait combination possessing no particular aberration (now in the Science Museum, London). But it is rather probable that they also used a short-focus landscape lens, particularly during the beginning of their photographic activity. The calotype process as well as the equipment used by Hill and Adamson required very long exposures (3 to 6 minutes) and was limited chiefly to outdoor photography. Therefore all their seemingly "interior photographs" were taken outdoors. Hill and Adamson probably made use of a mirror in order to accentuate the lights on the faces and the hands of their models. They were skillful in creating the illusion of an interior with the aid of a curtain, a table, a few books or other objects carefully arranged around their models in front of their studio and laboratory at Calton Stairs, Edinburgh.

It is not yet possible to distinguish Hill's and Adamson's individual contributions to their unique photographic oeuvre. However, the assumption is gaining ground that Adamson too had a very decisive part in the artistic merits of their work and that he was far more than merely the technical adviser and collaborator of his older friend. At any rate, after Adamson's departure from Edinburgh and his early death, Hill again devoted himself exclusively to painting and seems to have almost completely abandoned photography for more than a decade.

Distinguished contemporaries, such as Sir Charles and Lady Elizabeth Eastlake, F. G. Waagen, Hugh Miller, John Gibson Lockhart, and many others appreciated already at an early date the high artistic quality of these calotypes and their outstanding and unique rank in the vastly increasing deluge of photographic production. As early as in 1844 some of their calotypes were put before the French Academy of Science and greatly admired. Through the photographic exhibitions of London (1851, 1862), Edinburgh (1854, 1856, 1861), Birmingham (1857), and Manchester (1861) the general public too became acquainted with the photographic work of Hill and Adamson.

About 1860 Hill's interest in photography, apparently dormant since Adamson's death, was again awakened. In 1861 (Manchester,

Edinburgh) and in 1862 (London) Hill exhibited some recently produced photographic portraits and genre pictures as "Contributions towards the further development of fine art in Photography." However, according to contemporary reviews, these newly produced photographs were less his work than that of the Scottish photographer McGlashon (died 1877), "assisted by the artistic skill of D. O. Hill." Nevertheless Hill was awarded a silver medal for one of those photographs ("Dr. John Brown and his cousin") as the best portrait shown at the Sixth Annual Exhibition of The Photographic Society of Scotland (1861). These late works of Hill and McGlashon probably were made by the collodion process; certainly not by the outmoded calotype process. Among those late works were also to be found genre pictures which were undoubtedly influenced by H. P. Robinson and O. G. Rejlander.

From that time on Hill's name as a photographer fell into oblivion. It was not until the late nineties that Hill's name was recalled to the public attention, especially through the great exhibition of the Royal Photographic Society in Crystal Palace, London, 1898. In 1914 a monument was erected for Hill in his native town of Perth.

To America Hill was introduced in 1905 by the periodical *Camera Work*, founded and edited by Alfred Stieglitz, and later through the exhibitions of the Albright Art Gallery in Buffalo (1910, 1915).

A considerable number of Hill's waxed paper negatives are still preserved and can be printed. A. Elliot, J. Craig-Annan, F. C. Inglis, and A. L. Coburn have, since the late 90's, made new prints partly with the aid of those original paper negatives.

Collections of Hill's and Adamson's works, some of them still in the original albums compiled by the artists, are to be found in:

Edinburgh: Royal Scottish Academy, Scottish National Portrait Gallery, Photographic Society, Andrew Elliot, F. C. Inglis, etc.

London: Royal Photographic Society, Camera Club, Victoria and Albert Museum

Berlin: Staatliche Kunstbibliothek, Prof. Dr. Erich Stenger

Dresden: Kupferstichkabinett



NEWHAVEN FISHWIVES. From a calotype print made by Hill and Adamson in about 1844. It is an excellent example of their genre work. "They used the grain of the paper like painters," writes L. Moholy in *A Hundred Years of Photography*, "to build up the tone values, avoiding hard lines and sharp contrasts. Unimportant details are absorbed partly by the grain, partly by the shadows"
Collection of A. E. Marshall

Hamburg: Museum fuer Kunst und Gewerbe
New York: Metropolitan Museum, Dr. Heinrich Schwarz, Edward Steichen, Alfred Stieglitz
Buffalo: Albright Art Gallery: Coburn-prints

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Heinrich Schwarz, David Octavius Hill: Master of Photography. New York (Viking Press), 1931. With 80 ill.

G. W. Wight, Early Photographic History in Edinburgh. "The Photographic Journal," London, January 1941, pp. 9 ff.

HILL CAMERA. The Hill camera, designed in England by Robin Hill, has an angle of view of about 180°—making it possible to photograph the entire sky on one negative. It was originally designed, in the 1920's*, as an aid to meteorological study, where a record of the entire sky and its cloud formations was needed. It has been used also to create interesting distortion photographs (see page 656).

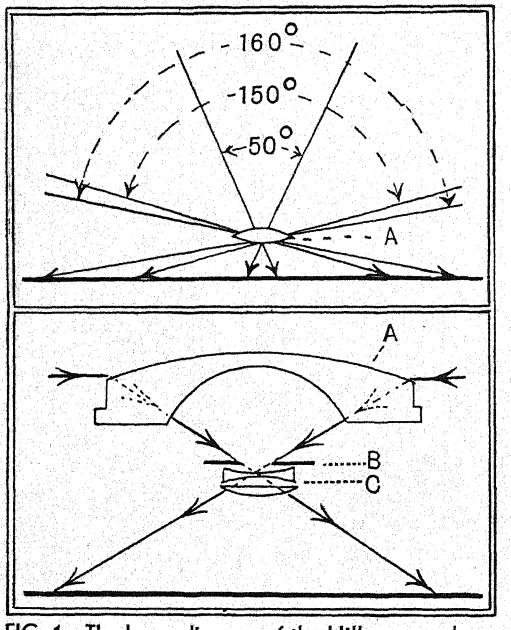


FIG. 1. The lower diagram of the Hill camera shows (*A*) the top lens, (*B*) the position of filters and stops, and (C) the inside lens. It can be seen that light rays from the horizon strike *A*, pass through the opening at *B*, and reach the regular photographic lens, *C*, at an acceptable angle

The Camera's Design. The average camera lens has an angle of view of around 50 to 60° and a wide-angle lens has a greater angle, of course. However, it is obvious that there is a practical limit to the angle and that an angle of 150° with the usual focal length would require a film of approximately 3 feet in diameter in order to record the entire image; a lens of 180° would take film of much greater size. Robin Hill's design incorporates two widely separated lens elements—the top lens contracts the incident angle of the light from the horizon to about 90° and the light is then transmitted to the film through a normal wide-angle lens below. As shown in Figure 1, the lens *A* has a diameter of 2¼ inches with a curved convex outside surface and a deep concave surface inside. Thus the rays near the horizon are bent in the manner shown and the rays from the normal front position go to lens *C* undeviated. The slot at *B* is for stops and filters. And the entire set-up, which cannot be focused, has an aperture of f/22, thus providing extraordinary depth of field.

The camera, actually, is based somewhat on the principle of the fish's eye. When a ray of light goes from a rarer medium (air) into a denser medium (glass), the ray is bent—and this is greater if there is a plane of separation between the media. Thus the fish's view of the aerial world shows 180° compressed into an angle of view of 97°. Scientists who first worked on the principle,** actually tried to reconstruct the fish eye by building a pinhole camera partly filled with water and covered with a glass slab. Hill arrived at the idea of replacing the water with a portion of a glass sphere.

The Camera's Use. The lenses of the Hill camera are mounted about 1 inch above the plate or film (as shown on page 656) and produce an image 2½ inches in diameter. The lens is fixed at correct focus and exposure is made by removing the lens cap. Stops and

*Robin Hill, *Quart. Journal Royal Meteor. Soc.*, 50 (1924) 227.
**R. W. Wood, *Physical Optics* (1919) 67.

filters are inserted by means of levers. On a panchromatic film with a Wratten A filter, the exposure required for a well-lighted sky will not exceed a second.

One difficulty for the photographer, when using the camera, is to avoid being included in the picture. Photographers taking interiors may leave the room during an exposure, but the best method is to set the camera up on a low tripod or other support and then lie down flat on the floor or ground during the exposure. Another difficulty is, of course, the distortion necessary when recording a global image on a flat plane. For purposeful distortion and for some meteorological work this is not an obstacle (Fig. 2). But it is possible to convert the image into a number of normal photographs. This is done by placing the negative in the camera and reversing the action of the lens set-up during printing.

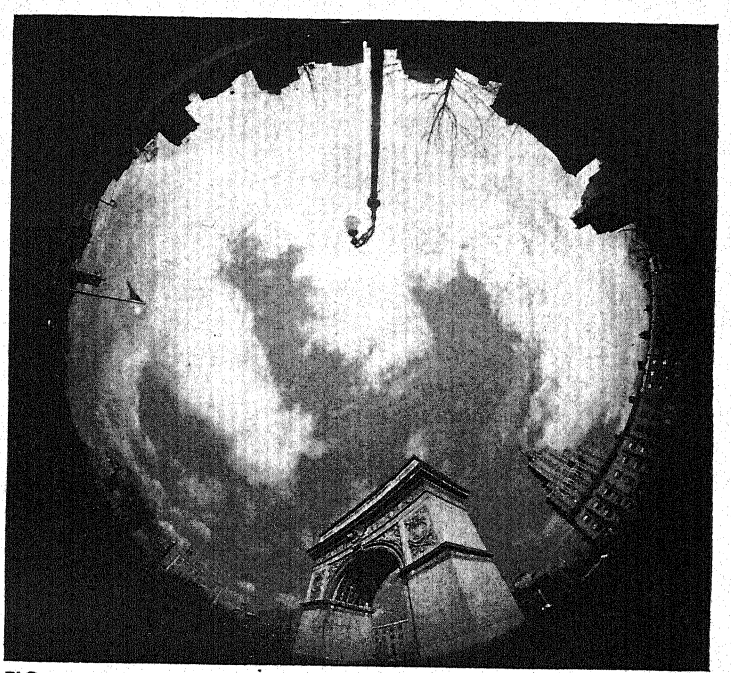


FIG. 2. A view of Washington Square in New York, as taken through a Hill camera
Photo, Ralph Steiner

LEWIS W. HINE

Elizabeth McCausland
Art Critic, The Springfield, (Mass.) Republican; *Writer of text for* Changing New York

Lewis W. Hine, who took remarkable photographs particularly in the early part of this century, is said to be the father of contemporary photo-journalism. His photographs of immigrants, child labor, and skyscraper construction are famous, and an account of his work and influence on later photo-journalism is given here.

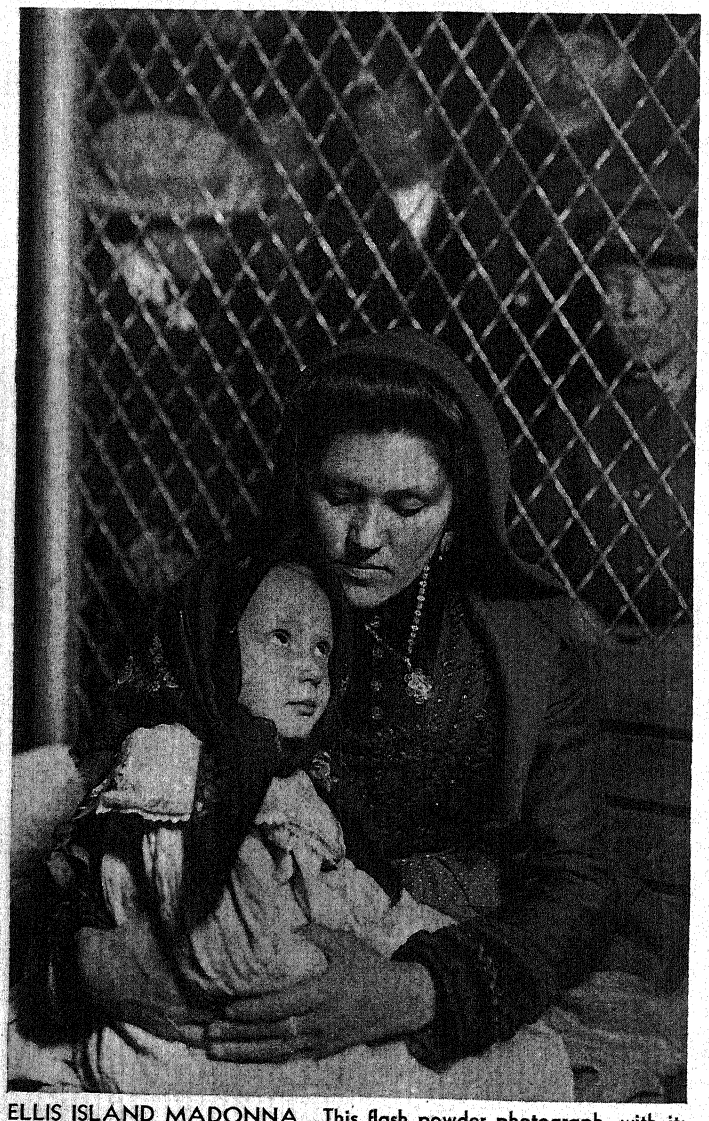
See Also History of Photography

PHOTO-JOURNALISM is as old as photography. But its spectacular rise has come within the past few years. Following the comic strip, photo magazines use pictures linked by a scenario of short, snappy captions to tell their story. But the photo story is not new. Thirty years ago it was being told by a man who ranks high among American documentary photographers—the late Lewis W. Hine, who died November 30, 1940. Intuitively he anticipated the current trend for a closer liaison between photographer and writer. His pioneer work is a model for today.

PIONEER PICTURE STORIES

When Hine started photographing, he did so with a purpose. He was not just a hobbyist, pleasing himself. He was a reporter in pictures, a visual educator awakening people to real life. The romance, the tremendous human drama of immigrants at Ellis Island was his first theme. Soon he was working closely with the early twentieth century social welfare and reform movements. Thus his work was first published in social work magazines, which used photographs and text as inseparable parts of a *whole* story.

This was no accident. Titles of those pioneer photo stories prove they were carefully planned, as the material also shows. In January, 1909, came the first, "Child Labor in the Carolinas" by A. J. McKelway with "some human documents" (photographs) by Lewis W. Hine, published in *Charities and the Commons*. Thus editors gave the photographer a by-line equal in honor to the writer's. The next was "Climbing into



ELLIS ISLAND MADONNA. This flash powder photograph, with its superb photographic technic, is a sensitive portrayal of an immigrant mother and her child waiting behind the bars of Ellis Island before being admitted into this country. Hine's photo story of these people was first used in a social work magazine

America" in the *Survey*, photographs by Hine with captions anonymous. In July, 1909, *Everybody's* used a 12-page section of photographs and captions by Hine. A little later the *Survey* printed a special 8-page insert on coated stock, "Southerners of Tomorrow," again photographs and captions by Hine. The same month the *Outlook* published "Day Laborers Before Their Time: A Story in Pictures by Lewis W. Hine," comprising 8 pages and 14 illustrations.

By 1910, the photo story was well established as a vivid means of pressing home significant sociological truths. In January, the *Survey* featured "The Construction Camps of the People: Findings of An Automobile Tour of Investigation of Camp Conditions Along The Line of New York State's New Barge Canal and New York City's New Aqueduct" with text by Lillian D. Wald and Frances A. Kellor and photographs by Hine—a 16-page insert with 23 photographs and captions and 16 additional pages of text. In July, *McClure's* published "Toilers of the Tenements: Where the Beautiful Things of the Great Shops Are Made" by Elizabeth Shepley Sergeant, with photographs by Hine—16 in all, 10 of them half page cuts in a special insert with explanatory captions, and in addition 18 pages of text.

The first use of the name "photo story" which the writer has noted was made in the February 7, 1914, *Survey's* article "Children or Cotton: Photo-Story by Lewis W. Hine." Five years later it was used again in the *Survey* of September 6, 1919, in "The Children's Burden in the Balkans: A Photo-Story by Lewis W. Hine and Homer Folks." Purposes of photojournalism are suggested in a title in the *Mentor* in 1926, "He Photo-Interprets." This brief ramble through files of old magazines indicates the sound psychological basis for the photo story and offers a precedent for present-day workers.

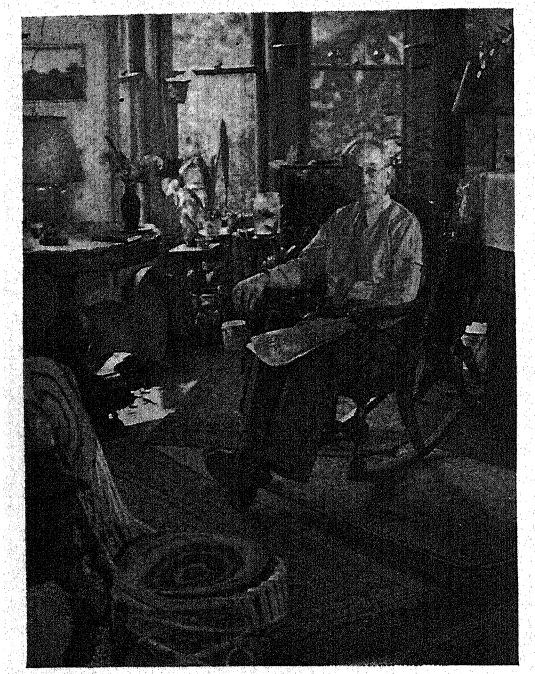
HINE'S METHODS AND ATTITUDE

Hine worked closely with his editors and writers. He understood that photographs

should be buttressed by material which cannot be presented visually. For example, the age of a child working illegally in a cotton mill is susceptible to pictorial presentation only by inference, if the child is photographed beside some object of familiar reference, as a window sill, or beside a full-grown man whose maturity is signified by costume, mustache,



IMMIGRANT. A close-up taken in the first decade of this century, here is a sympathetic portrayal of time-worn character and part of the Hine photo story on immigration



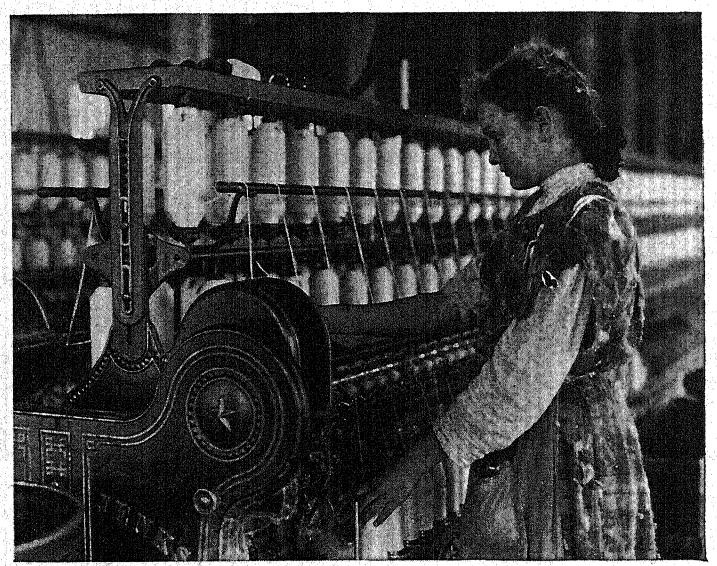
LEWIS W. HINE. This photograph was taken in 1939, a year before his death, at Hastings-on-Hudson
Photo, Berenice Abbott

etc. Hine talked to children in the mills and made surreptitious notes, writing with his hand concealed in his coat pocket. Later he managed to photograph the entries of their birth in family Bibles, on the pretext of gathering data for child life insurance. Such data was indispensable for the purposes of the photo story. Wages, hours of work, etc., also can only be visualized by indirection. Data on these points was obtained by superior detective work on the photographer's part.

Diplomacy was Hine's great asset in entering the forbidden zones where child labor flourished, whether in Southern cotton mills, New Jersey cranberry bogs and canneries, or New York City sweatshops. Today the problem of the camera reporter has to an extent been simplified by the miniature camera. But Hine had to persuade first, before he could blaze away with hazardous magnesium powder. Inferior equipment or superior equipment, a major problem of photo-journalism is still to establish cooperative relations between reporter and his news source. Hine did it.

The proof is his work. Somehow he cajoled slum dwellers into forgetting the degradation (through no fault of their own) of their condition and so allowing themselves to be photographed naturally. Present-day photographers need an equally human approach if their work is not be patronizing and snobbish. More than this, Hine saw his subjects —immigrants, newsboys, coal miners, girls making artificial flowers, cotton mill operatives—as sentient beings, worthy of understanding. I can think of no photograph of Hine's in which contempt of humanity is evidenced. This is a great achievement.

An intuitive pictorial sense controlled Hine's early documentary photographs. They are emotionally expressive because he felt how lighting, cropping, and composition would focus attention on his central theme, those oppressed human beings for whom he and his editors were waging a crusade of justice. Through these esthetic attributes, he heightened the emotional power of his photographs and so made more telling and poignant the effect of his photo stories. Close



CHILD LABORER. This remarkable photograph of a young girl at her spinning machine was taken around 1909. It is truly a human document, telling the story of child labor in plaintive and graphic terms

study of Hine's photographs is a must for photo-journalists.

Fortunately these negatives have been preserved and they are now in the keeping of the Photo League, the New York City group of serious young documentary photographers who are carrying on the ideas and practice of Lewis Hine in the present period. As time goes on this archive of a pioneer American photographer will be found to possess both greater historical value and human communicativeness. As the document of a vanished era in American life, Hine's photographs will live.

HISTORIC ARCHITECTURE PHOTOGRAPHY: NEW ENGLAND

Marjorie Jephson

Journalistic Photographer, Madison, Conn.

The past of any part of our world can be well presented through the photography of its architecture. The historic knowledge and photographic technic needed are covered by a specialist in the photography of the architecture of New England—only one of the many interesting sections of the country which can be interpreted through pictures.

All Illustrations by Marjorie Jephson.

See Also Architectural Photography, Ecclesiastical Photography, Historic Architecture Photography: The Southwest

PROBABLY NOTHING made by man in any country so typifies the character of its people or expresses the trend of its social life as does its architecture. In New England one cannot but feel inspired by the beauty and fascination of its architectural style which has been developed from primitive simplicity to the present-day designs.

KNOWLEDGE OF ARCHITECTURE

By means of the camera, the writer has tried to bring out the interesting characteristics of the houses of New England which are renowned for their historical value. The requirements here are first to know the historic architecture and then to *show* it on film.

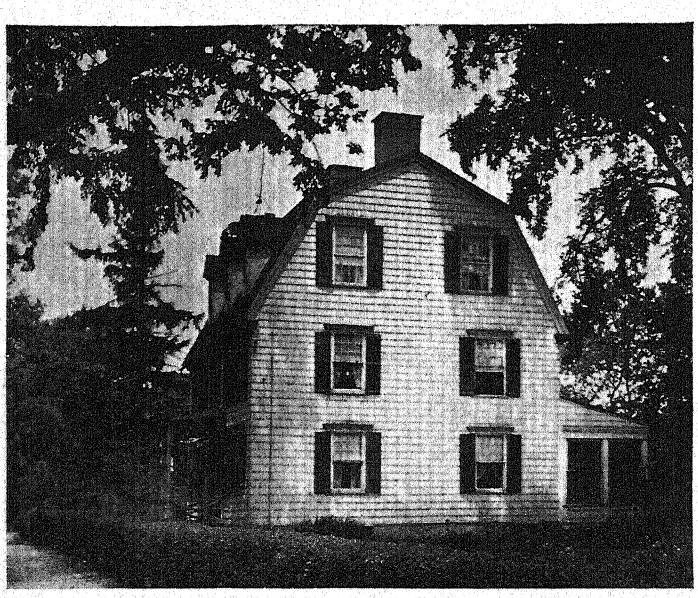
The growth in architectural development dates from the 17th century in this part of the country. The earliest type of house has not survived, as it was merely a makeshift in the form of a log hut. The first frame dwelling had two rooms with a chimney in the center and fireplaces on either side. The fireplace formed an important part in the construction of old houses and continued to do so until the latter part of the 18th century. The two-room house was followed by the framed over-hang, a type which shows the second story jutting out over the first. Stone and brick houses were also erected. The oldest stone house is the Rev. Henry Whitfield homestead in Guilford. Built in 1639, it is still in excellent preservation. In the 17th century the gambrel roof, the Cape Cod cottage, the hip-roof, and the salt-box had their hey-day. With the growing affluence of the people, the large colonial houses took on embellishments of design and no longer became expressions of the struggle and hardships of the builders.

PROCEDURE

In photographing old houses, one follows the same procedure as in taking pictures of any architectural study. The main object is to secure a faithful reproduction, or exact record. In order to do this the photographer



CAPT. FREDERICK LEE HOUSE. A double over-hang is the distinctive feature of this East River, Conn. house, built in 1747. And notice that the photographer has waited for a top sidelight in order to accentuate the clapboard construction and the double over-hangs



GAMBREL ROOF. The Mathias Nicoll Home in Stratford, Conn. (built in 1777) is shown with the typical gambrel roof, featured in the picture by camera position

must consider the general attractiveness and the chief beauty of line which designates the building as being of a certain period. The picture must be taken in such a way as to show the structure clearly. This requires sharp definition and an understanding of perspective.

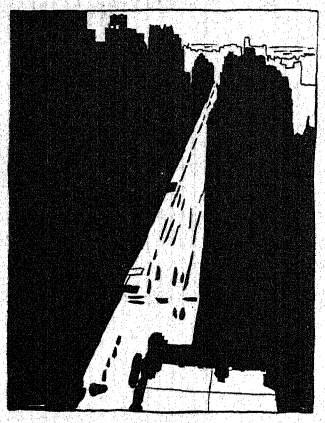
Sharp definition, as every photographer knows, demands the use of a small stop, which, of course, means a long exposure. Fear of distorting the perspective may lead one to believe that a camera with a long focal length is necessary. This is not so. A short focal length lens will not distort the perspective any more than a lens of long focal length. Distortion of perspective depends only upon the distance from camera to object. In architectural work, perspective is governed by the appearance of the image on the ground-glass. A range finder attached to the camera is also of great assistance in obtaining proper distance.

It is better to photograph any building at an angle instead of front on, unless there is a particular reason for doing so. There is always an important and unimportant side to every building. For instance, a "salt-box" house is typified by a short roof over the front and a long slope at the rear. By taking this house squarely in front, one is not aware of the important line and misses the main point of accent.

The time of day for taking such a picture should be when the most significant part of the building is brilliantly illuminated or when the shadows are cast at an angle of about 45 degrees. By taking several pictures at vari-

(Continued on page following insert)

COMPOSITION ANALYSIS for . . . CITY STREET



Here is a city canyon which is a canyon and a photograph which is a photograph. Anyone who has tried to extract from the city's welter of forms a simple statement of its grandeur knows how difficult that is. Here Berenice Abbott has, by rigorous simplification, created a masterful design which is at once realistic and abstract.

Low sunlight flooding straight into the perspective wedge of the street cleaves a floor between the dark flanking precipitous walls. By this lighting, all distracting detail in the building masses is reduced to a few directional highlights and low toned masses which are the only clues needed to establish elevation and form. Sweep of perspective is here in geometrical progression to the street's narrowed end, where it meets the opposing flat gray masses of the riverside buildings, the river, and the distant shore. Atmospheric haze is good relief against the sharp contrast of the foreground. Scale and sense of depth are geared to the miniature effect of cars and human insects moving in orderly cross-tides. Car tops, like polished beetles, add three-dimensional enrichment to the depth theme. Long shadows attached to the walkers adds that touch of the fantastic which one finds in photography—the most realistic of the arts.

This is more than a factual picture and more than an abstract composition. It is the veritable form of contemporary life. It shows relation, wherein modern man has dwarfed himself to these mammoth structures he has made.

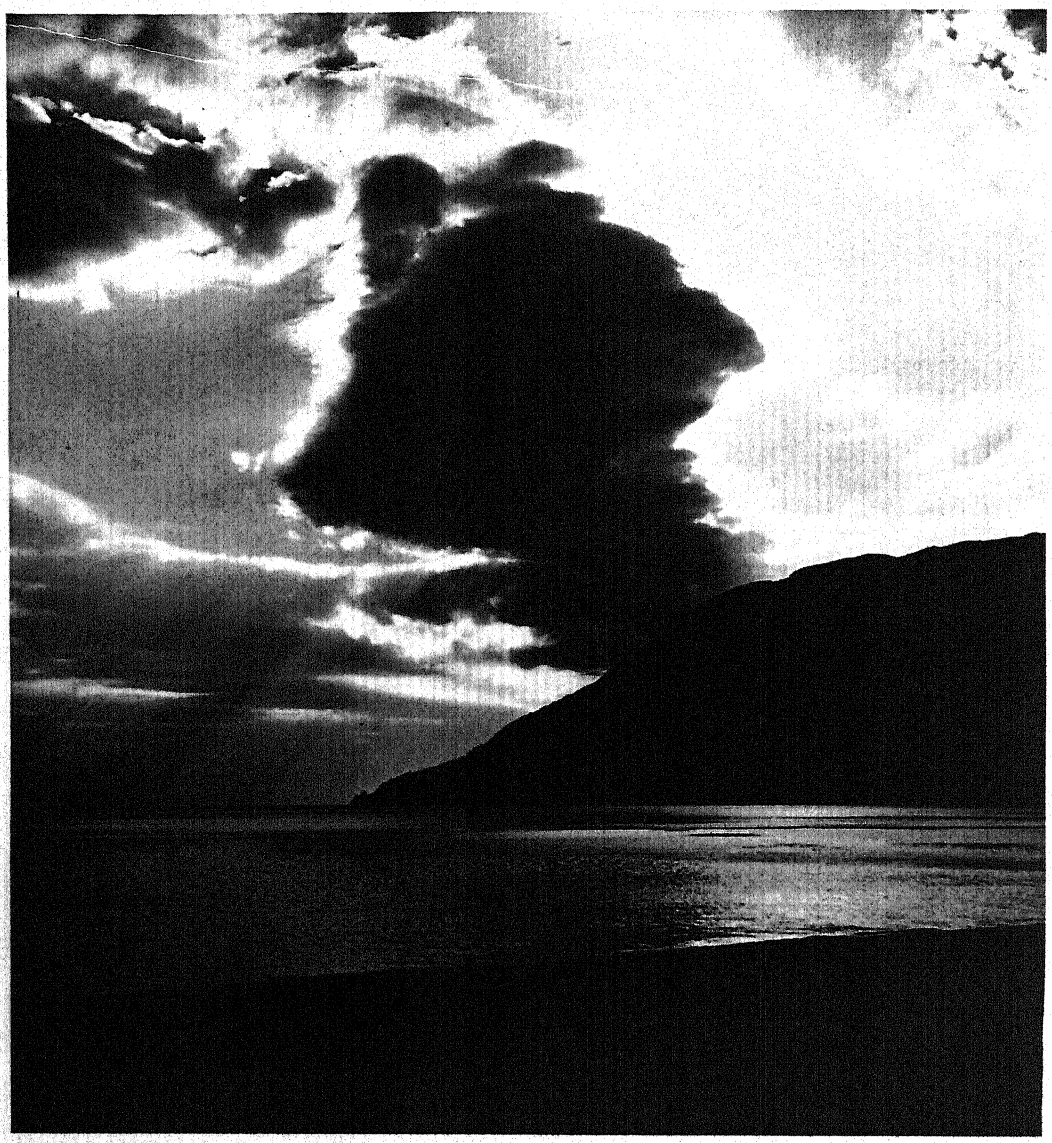
Barbara Morgan



CITY STREET

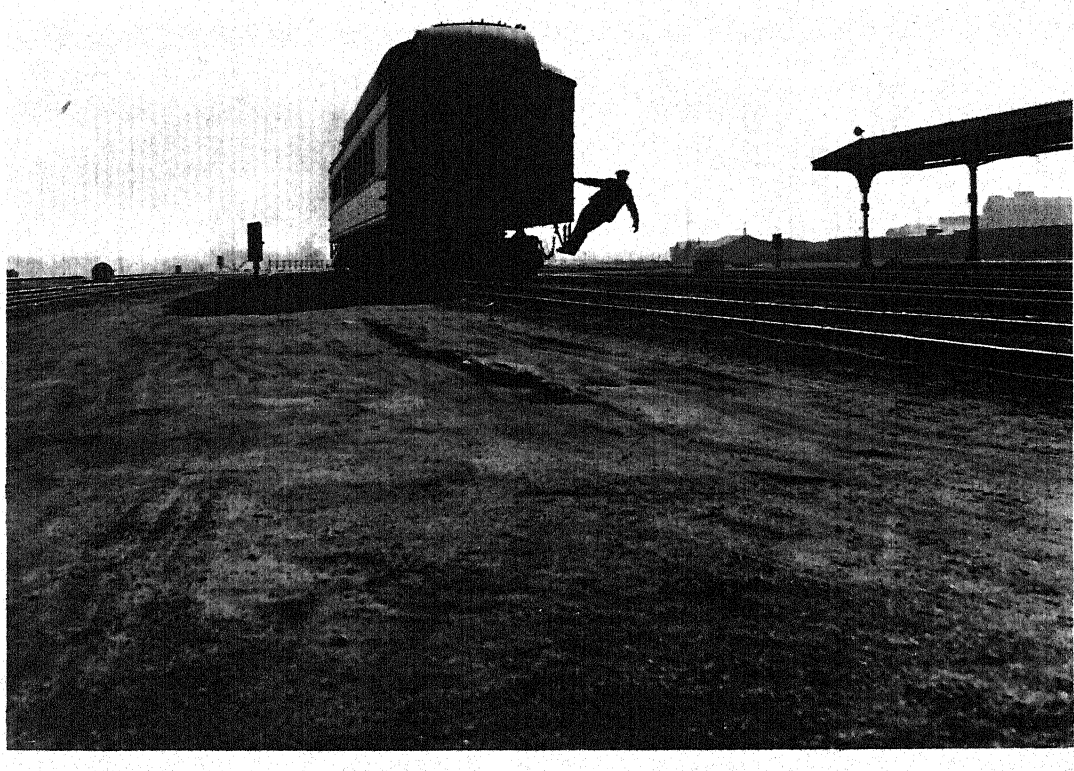
BERENICE ABBOTT

See the photographer's article on *Documenting the City*



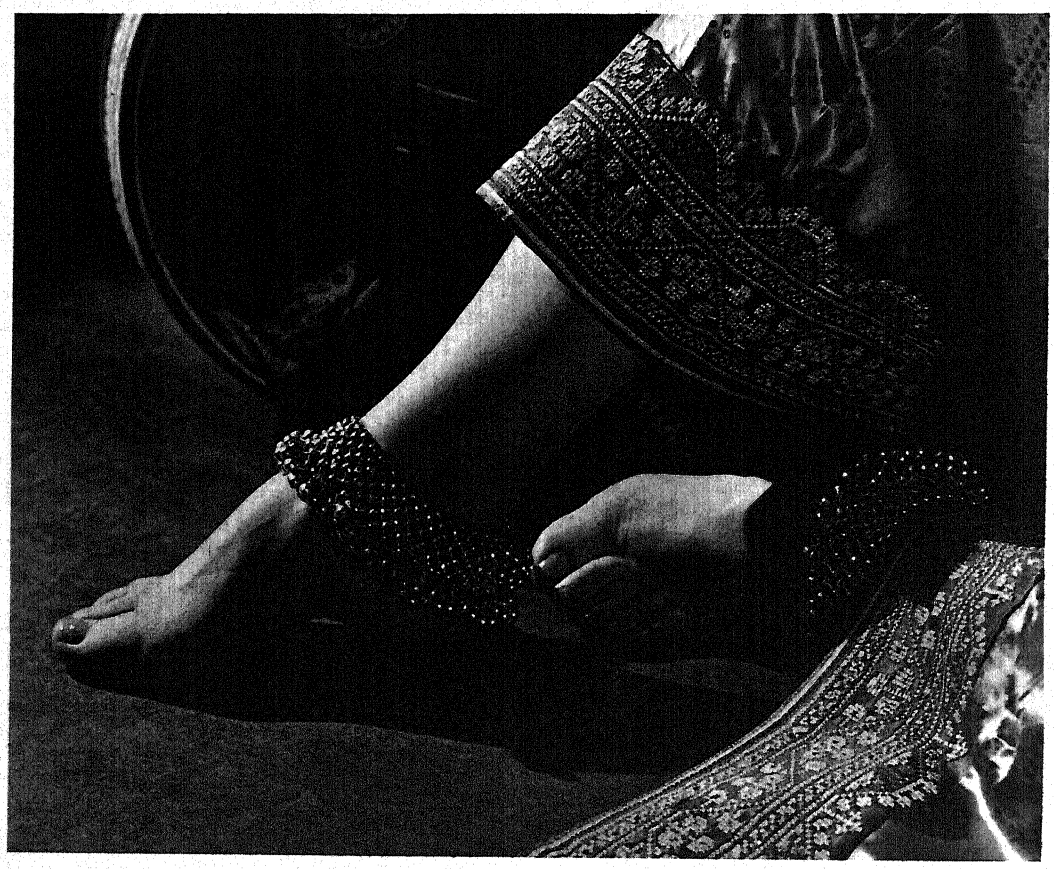
AMALFI DRIVE — G. E. KIDDER SMITH

A red filter helped to create this deeply silhouetted photograph of the famous Italian coastline near Naples. The wide scale of tones, from brilliant white in the sky to absolute black in the foreground, give interest to the picture, already well-composed in line patterns



END OF THE RUN **ERIK NITSCHE**

Many so-called rules of composition and photographic technic are broken in this unusual photograph. The sky is bald, the foreground is large and uneventful, and the center of interest is in the geometrical center of the picture. Yet notice the complete effectiveness of the composition—achieved because of these factors, not in spite of them



FEET OF A DANCER — **ALFREDO VALENTE**

A study of the feet of Mona Rani, Hindu dancer. Feet, like hands, can often express an idea as well as the whole figure—if not better, occasionally. In this photograph, the essence of orientalism has been expressed in the costume and background drum

(*Continued from page preceding insert*)

ous angles, one is able to secure a picture of fine contrast with details clearly registered in the shadow area. Due to the fact that houses face different points of the compass, one cannot say definitely what time of the day is the best. Shadows are longest in the early morning or late afternoon, yet in New England where the foliage is abundant and the shady maples and stately elms form excellent foreground and background, most any time of day may be selected. The worst time of day for any architectural study is when the sun is directly behind a building.

One cannot speak of the architecture of New England without mentioning its churches. The Greek design seems to predominate. Practically all these edifices have the typical Doric, Ionic, and Corinthian capitals. In taking pictures of these columns, various effects are obtained by different light distributions. Natural light cannot be controlled. So effects are brought out mainly in the design itself in relation to light from the sky (see *Ecclesiastical Photography*).

PHOTOGRAPHING INTERIORS

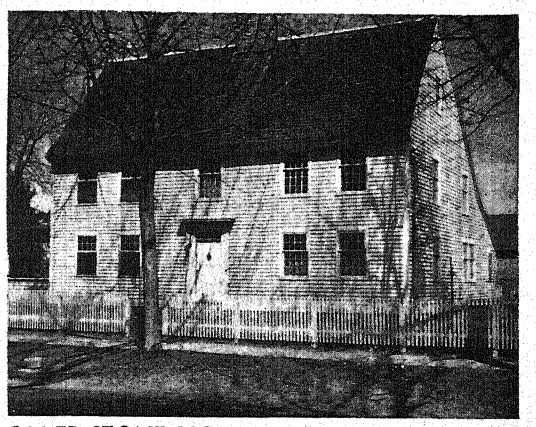
The secret of success in photographing interiors is in being able to control the light so that it will be uniform in all parts of the room being photographed. All detail must be recorded except where deep shadows are unavoidable. The light may be adjusted by raising or lowering the window shades, if the picture is taken in the daytime, or by the use of photofloods at night and possibly a spotlight for the darkest corners. In making interiors of old houses, I have discovered the necessity of using an auxiliary light, as most of the rooms have small windows. The use of reflectors greatly improves the illumination. Time exposures are usually made, so the camera must be supported by a tripod or some sort of firm brace.

EQUIPMENT

As to the equipment necessary, you can accomplish excellent results with any reflex type of camera. It largely depends upon the purpose of your prints. Above all, a good anastigmatic lens is necessary. An accessory wide-angle lens will allow a close-up shot when it is impossible to include the entire subject with an ordinary lens and it is also of great value in photographing interiors.

A camera with a rising front eliminates unnecessary foreground and a swing back is of great assistance in recording correct perpendicular. If your camera is not thus equipped, almost any converging lines of the perpendicular may be overcome by tipping the easel of the enlarger.

For some time I have been using a Miniature Speed Graphic for most exterior work. Equipped with a Tessar f/4.5 lens, rising front, focal plane and compur shutter, this camera can do most any kind of a job with efficiency. Its only drawback is in taking interiors, which are much better performed by the use of a view camera, 5 x 7 size. Contact prints made from view camera negatives are of excellent quality.



CALEB STONE HOUSE. A partial side view has brought out the interesting salt-box construction of this Guilford, Conn. house (built in 1766), showing the long sloping roof at the rear. Notice, too, that the photographer took this picture in winter, when nearby trees could not obstruct the view

By all means the use of panchromatic materials is essential. Panatomic-X for exteriors produce fine grain prints, and for interiors Supersensitive Panchromatic are best because they have a sensitivity to artificial light which is superior to any ortho film. Also, the use of filters adds greatly to the quality of your work. And the use of filters is a subject in itself. In brief, I have found that for exterior work a yellow filter, either K1 or K2 or Agfa 1 and 2, is all you need for ordinary work. X1 and X2 are the best filters with Supersensitive Panchromatic films or plates.

HISTORIC ARCHITECTURE PHOTOGRAPHY: THE SOUTHWEST

Laura Gilpin

Architectural and Portrait Photographer, Colorado Springs; Author of The Story of the Pueblos

This article covers both the esthetics and the down-to-earth business of photographing architecture in the Southwest. We are told how the Southwest's native cultures can be translated into terms of black and white by a photographic artist who has successfully done just that for many years.

All Illustrations by Laura Gilpin.

See Also Architectural Photography, Ecclesiastical Photography, Historic Architecture Photography: New England

THE PHOTOGRAPHY of architecture is as old as the art of photography itself. For the past hundred years, since the days of David Octavius Hill, photographers of all countries have been picturing architectural subjects. Many of these are of lasting value, real works of art, interpreting great monuments of architecture. Others are merely photographic records, without pictorial value.

What are the reasons for the difference in these photographic prints? It may be said generally that one group embodies the qualities which are found in the original subjects, expressed through fine design, while the other group does not. In the first group, great consideration has been given to the proportion, the spacing, the form and the lighting of the architecture, as well as thought of its purpose, all of which have been expressed in the form of the design. In the second group a mere record was made, of technical excellence perhaps, but without creative value.

The importance of understanding architecture itself—its function, its character, its general mass, its smaller portions, its ornament or lack of ornament—cannot be too strongly emphasized. It is only through such knowledge that the photographer can intelligently relate the general plan of his picture to its minor parts and, through the means of the design, give an adequate interpretation of the original.

It is the purpose of this article to give a photographic approach to the specified field of Western Historic and Primitive Architecture, and to set forth a method of obtaining pictures of old structures. The same technics may be applied to other districts.

EQUIPMENT

It is taken for granted that the photographer has a working knowledge of the technic of photography before embarking on such a specialized field. As a general rule, it is well to keep one's equipment as simple as possible, but the definite requirements are:

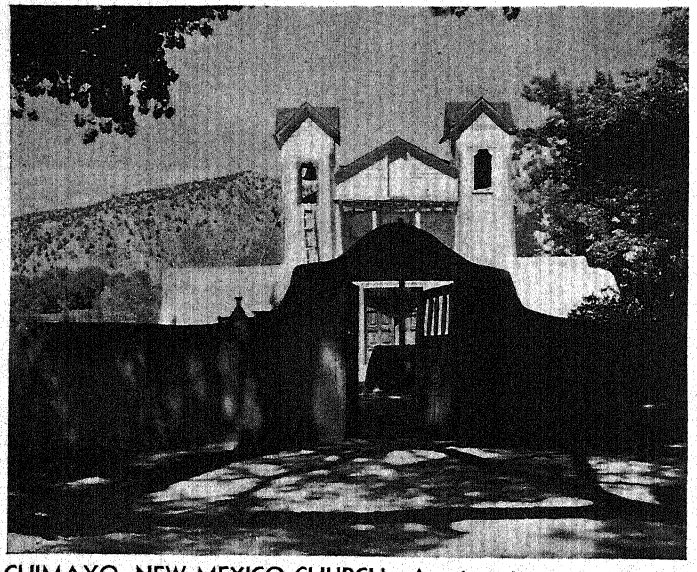
1. A view camera with swing adjustments, either a 5 x 7 or an 8 x 10. Swing adjustments are often a necessity in all forms of architectural photography.

2. A good tripod which will withstand vibration from wind and other forces. Sometimes two tripods can be used, one supporting the rear extension of the camera.

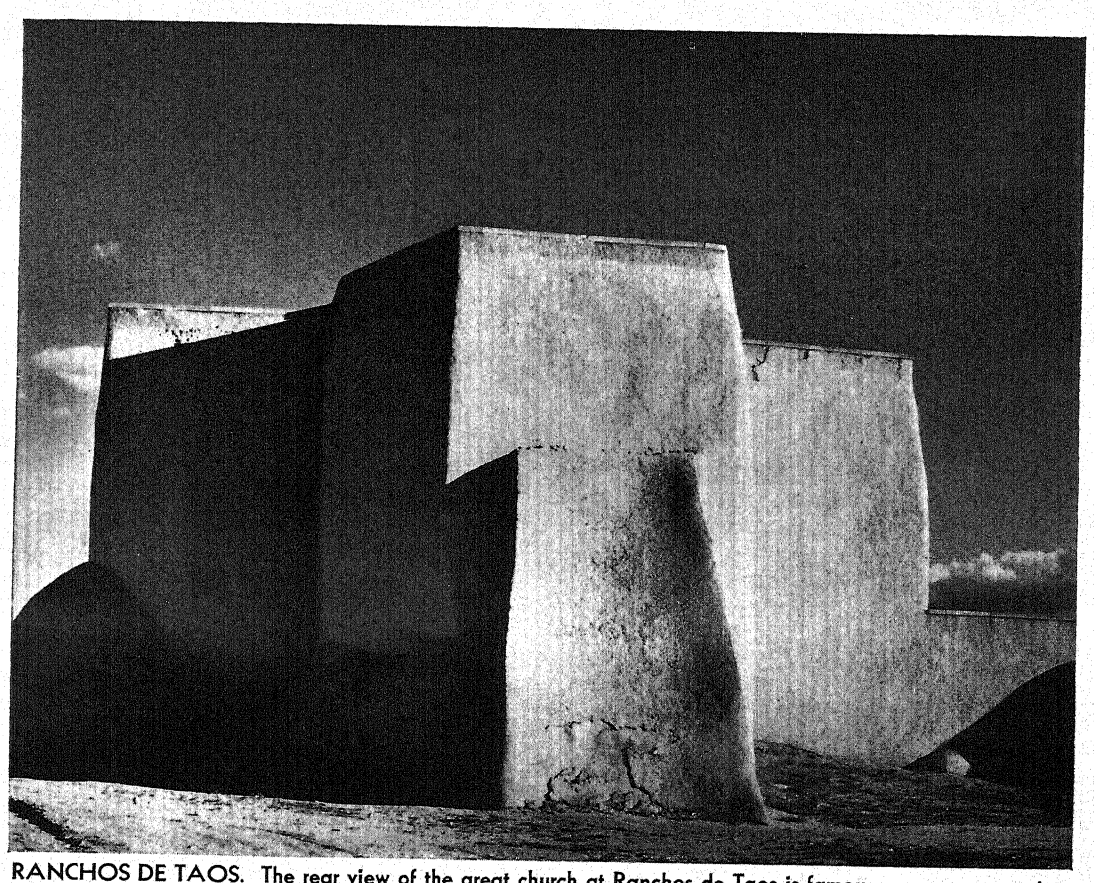
3. Lenses of several focal lengths. A wide-angle lens, a normal lens, and one or two long focal length lenses.

4. A lens hood that will not cut corners when the lensboard is raised.

5. Filters. A K2 and a G will do most of the work. Occasionally an A filter is



CHIMAYO, NEW MEXICO CHURCH. A unique interpretation of a crude but interesting piece of architecture. The right lighting accentuated the tonal planes of wall, building, and landscape and gives the appropriate feeling of glaring light and deep shade so typical of the climate



RANCHOS DE TAOS. The rear view of the great church at Ranchos de Taos is famous, as everyone paints and photographs it. Its characteristics are bulk, beautiful proportion, and surface texture. The extreme subtlety of its tonal values is difficult to express in pictorial form while revealing, at the same time, its sense of bulk

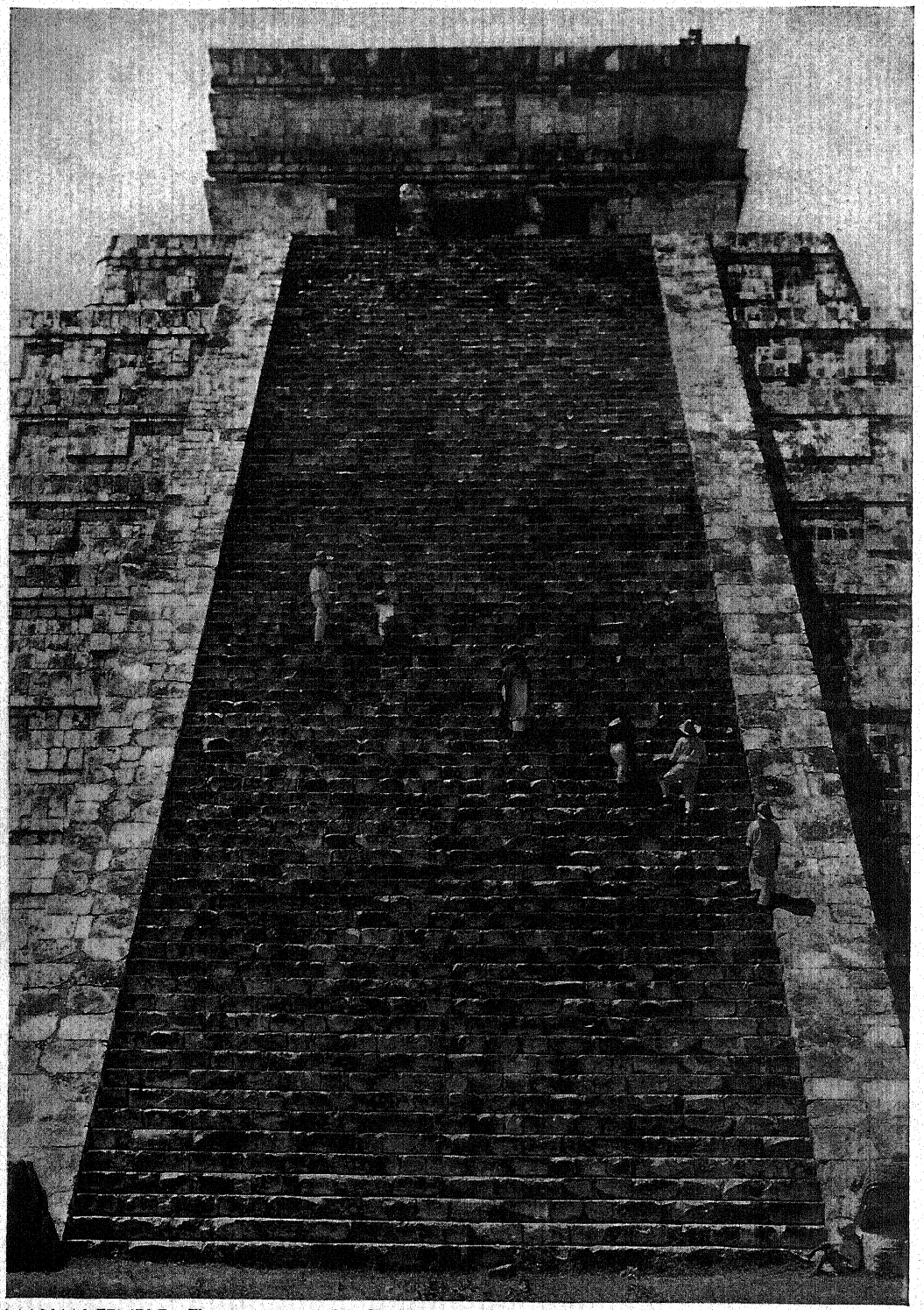
needed for special effects or to cut through haze or smoke.

6. A large, lightweight-, light-tight focusing cloth.
7. Plate holders.
8. An exposure meter.
9. A changing bag.
10. Miniature cameras can be used for rare and inaccessible shots, but otherwise the large camera will do the work more easily and with greater efficiency.

DESIGN

Design, composition, organization—whichever term you prefer—is the foundation of all art. In photography, or any black and white medium, it is vital. It is by means of the design, the scale of tone values employed, and their relationship to one another that the idea is expressed. The design must interpret the character, the lighting, the form, and texture. Thus two fundamentals in photography are design or pattern and lighting or tone values. Many enter the field of photography with the impulse to record a scene. They often fail to realize that what they wish to do is to record the emotion felt upon viewing that scene, and consequently a mere record photograph in no way reflects that emotion.

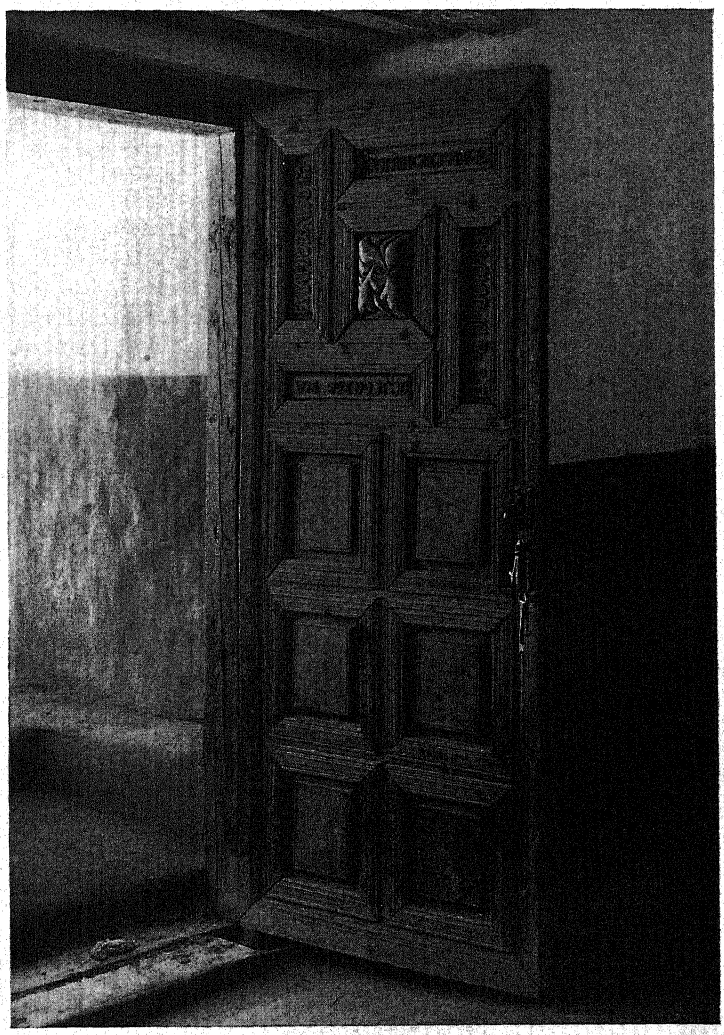
In order to be creative in photography, one must learn to disassociate the reality from one's interpretation or use of that reality. The groundglass must be used as a drawing board on which the elements of a design are arranged and harmonized to fit a desired idea. It is through this process that the camera ceases to be a recording instrument and becomes a tool to express the thought and feeling of the creative artist. The photographer's pencils are rays of light, controlled not by the hand but through the



MAYAN TEMPLE. The enormity of this Chichen Itza, Yucatan temple can only be comprehended when human figures are included for scale. These figures were very carefully placed on a diagonal to join the two sides, with the little boy at the base breaking the horizontal line at the bottom

camera, while the art of both is controlled by the human mind.

One may well compare photography with music. Photography uses waves of light, composed and harmonized to express an idea. Music uses waves of sound for the same purpose. Unless sound waves are arranged to fit a pattern which contains a basic idea and which is expressed through pattern, line, harmony, and tone values, they have no meaning and are merely a confusion of sounds. The same is true of photography, even to the terms employed.



CARVED DOOR. A detail to show the fine old carved door with its wooden hinge and old Spanish lock. The lighting reveals the depth of the carving and texture of the wood
Courtesy of Taylor Museum, Colorado Springs Fine Arts Center

LINE AND TONE

A photograph is composed of two elements, line and tone. (It can perhaps be more truly said that there is only tone, continuous from white to black.) Line (or what appears to be line) is given us by the object, tone, by the light or absence of light. Form is expressed through light and shade, for without shadow form is not visible. Thus, to express pure line, there should be no shadows, and to express great bulk or form, there must be deep shadows, not necessarily deep in tone but deep in drawing, to give a strong impression of the third dimension. The finished print in black and white must be visualized when studying the object on the groundglass.

The need for fine design in architectural (or any other) photography should be obvious. Much thought should be given to the proportion, not only in the design of the picture but also in the original. According to Webster, "proportion is the harmonic relation between parts or different things of the same kind." If a building has fine proportions, then the photographic interpretation must also have equally fine proportions if it is to convey the impression of the original. The proportions of the architecture are made out of stone, wood, or clay, assembled in form or bulk; the proportions of the photograph are made of line and tone assembled on a flat surface.

SCALE OF THE SUBJECT

Another important point for consideration is the scale of the subject. Scale is relative dimension. Sometimes this is very difficult to express. The inclusion of an easily recognizable object will readily give this expres-

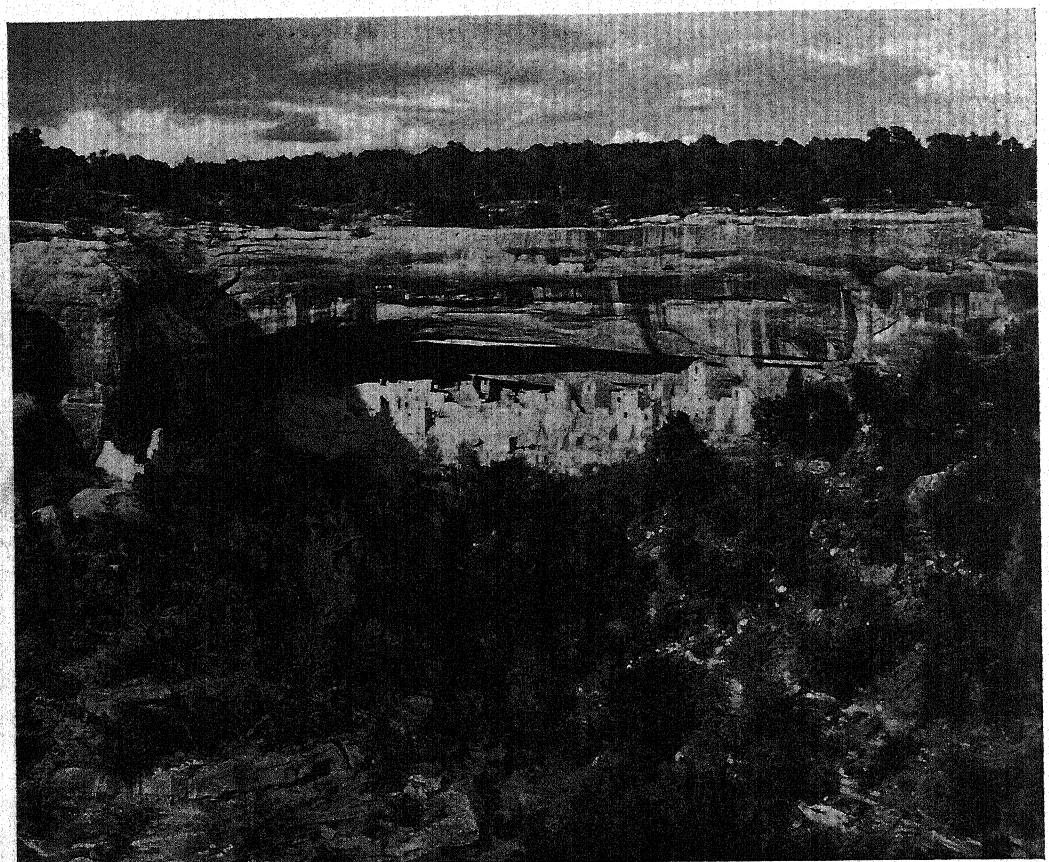
sion. The human figure can be used, but care must be taken that the figure itself maintains its relative proportion to the whole, for should it be too near the camera it will be too large and will dwarf the building.

One of the most difficult pictures to make of any building is the "whole view." It is usually a necessary one. Here the location of the building and its setting should be well considered. If possible, the design may be bound with bits of foliage or some surrounding objects, such as cliffs, trees, or other buildings. The surroundings may often help to express the function of the building. This should be emphasized if possible.

DETAILS

The important façades, or large sections of the building, should be worked into fine designs. These are much less difficult, and sunlight and shadow can usually coordinate the main elements of such pictures. Details are necessary also, for they convey the knowledge of construction, material, and ornament, and complete the series. It is necessary to study the lighting at all times of day. The atmosphere of the region is also important. In a country where the sun shines brilliantly most of the time, this sunlight must be felt in the picture. This can best be done by an interesting pattern and contrast of sun and shadow. Sometimes shadows from some other unseen part of the building can be used. The lighting best suited to show the details must be found. Sculpture, for instance, needs a strong side- or toplighting, especially in relief.

Searching out the aspects of a building under various lighting conditions, finding interesting patterns, working always for the



CLIFF PALACE, MESA VERDE. Tucked away in a recess of a canyon are cliff dwellings, as shown in the photograph. The idea of the picture is to give the feeling of hiding and protection which are the dominant characteristics of all such dwellings. By waiting for the right time of day, the light struck the structures, revealing their general character



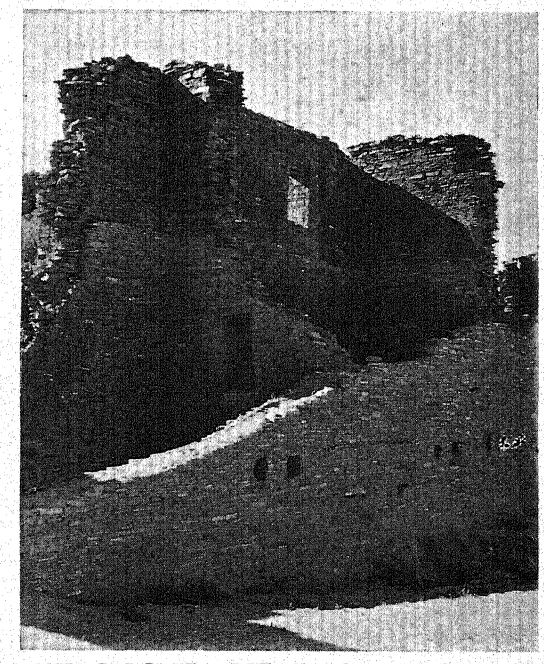
PUEBLO BONITA. Indians who built on the surface of the land apparently felt safer from attack than the cliff dwellers and this photograph shows the kind of site which they chose. An agricultural people, the pueblos chose the open plains for their communal houses

feeling of the character of the whole, is a most interesting work. To select a special historical sequence adds a still greater interest, where comparisons and relations in individual expression are found, giving greater value to the pictures.

HISTORIC BACKGROUND

Few people realize how extensive and how fine are the architectural monuments of the Southwest and of Central America. In New Mexico, Arizona, and southern Colorado—a portion of that area known as the Southwest —there are architectural remains of two distinct civilizations in addition to our own, each with its definite purpose and unique character. These are: the Indian civilizations which peopled all of America, Central and South America, prior to the advent of the Spanish Conquerors; and later Spanish civilization, modified from its old world origin by local adaptation. The height of the Indian civilization was reached in Central America and Mexico, while the more primitive aspect is found in the Southwest.

Cliff Dwellers. To the Indian cliff dweller, the function of his building was to provide a safe place in which to live, a dwelling which could be defended against a vastly superior number of nomadic, warlike raiders, and also a safe place for the storage of his precious corn, on which the life of the civilization depended. Also, protection from the elements played an important part in the selection of the building site. In many parts of the Southwest area nature has provided hundreds of great caves, many of them situated high in the rocky cliff walls of gigantic canyons, and many of them having exposure to the southwest. This exposure gave the greatest possible protection from the weather. And these caves offered the cliff dwellers two of their major needs, inaccessibility and invisibility. Often the caves are found in the bends of canyons, where travellers, hunters, or marauders would be unconscious of their presence until they came upon the hidden recesses around rocky promontories. To add

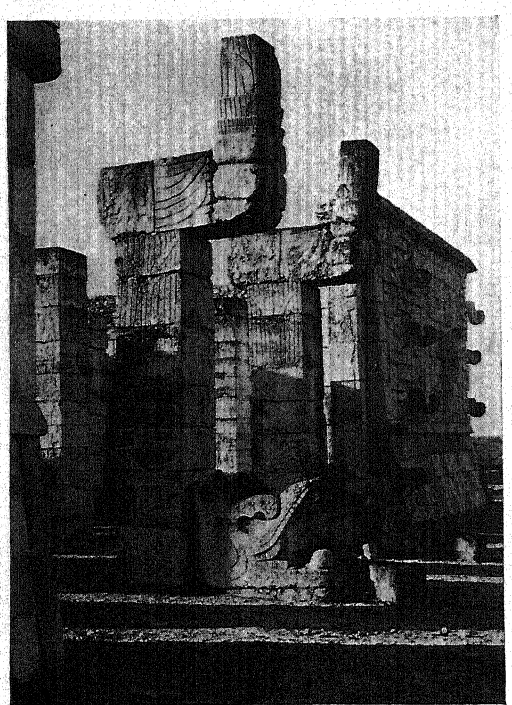


PUEBLO BONITA DETAIL. Some of the pueblo dwellings were five stories in height. This shows how they were constructed, and careful exposure control has given finest detail even to the shadows

to what nature had already provided, the Indians built their houses of the same stone as that from which nature carved the caves, stone blocks, all faced with stone tools. This also gave an excellent camouflage.

In photographing these dwellings one should seek to interpret these qualities of concealment and protection. Often it will take a strong play of light and shade to make the buildings visible at all from a distance. To find and reach the proper vantage points entails many a long and arduous climb, for the cliff dwellers certainly knew how to achieve inaccessibility.

Pueblos. In many places in the Southwest are found also the remains of great structures on the surface of the land. Here the Indians were usually concentrated in larger numbers and evidently felt themselves safer from attack. These early American builders were an agricultural people, raising crops of corn, beans, and squash, and hunting game. They were sometimes raided by nomadic tribes of less civilized Indians who roamed the entire country. The buildings necessary to the needs of these larger groups of farmers were great communal dwellings, where many people could live within a specified area, and where to some extent they could defend themselves if necessary. From this need arose the terraced pueblo, rising often to a height of five stories on a three-sided enclosure. One great structure is Pueblo Bonito in New Mexico, which covers an area of six acres and contains eight hundred rooms.



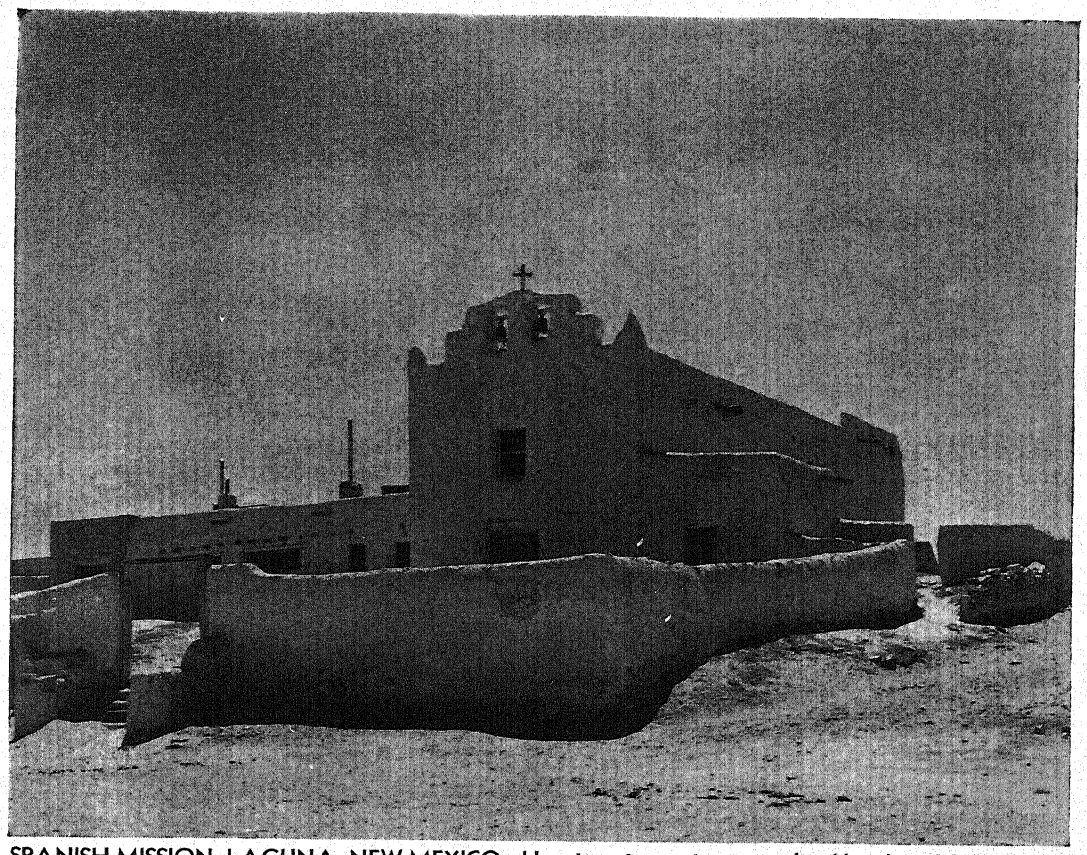
DETAIL AT CHICHEN ITZA. The Mayan temples of Yucatan show decorations which were both barbaric and delicate. The feathered serpent columns form a gateway to an inner court which was once roofed over. Lighting plays an important part in showing forms and texture

In all this ancient civilization, both cliff dweller and pueblo, the religious life centered in the kiva, which was a circular ceremonial chamber located beneath the ground. In the cliff dwellings there are the remains of many kivas. Presumably there was a kiva for each clan. In the pueblo ruins (and in the pueblos in use today) there are also a number of kivas. These are generally located in the plaza, near the open side of the pueblo.

Space does not permit here more than a general outline of the functions of this 11th to 13th century architecture in the Southwest. A certain knowledge of the lives and needs of these people is necessary to interpret adequately the remains of the ancient buildings. It is a fascinating work, one which leads to many bypaths of interest and beauty and one which creates a growing respect for our predecessors.

Mayan. South, in Old Mexico, are found temples of magnificent beauty. Here we have a far higher degree of civilization than that of the Indians of the more northern climate. And doubtless climate had much to do with this development, for it was in the valley of Mexico that the Indians discovered the wild Tiosenti grass from which they developed their perfected corn or maize. Many natural wild fruits and vegetables also were grown and gathered, so that life was easier in this milder climate and time and thought could be directed elsewhere than to the struggles for subsistence.

The ancient Mayans proved themselves to be builders and artists of great attainment. One difficulty in photographing these great temples is to retain their remarkable proportions and decorations and the beautiful surface qualities of the material, and at the same time retain the austere and barbaric qualities which are also present. From the practices



SPANISH MISSION, LAGUNA, NEW MEXICO. Here is an interesting example of hand-modeled surfaces. A partial side view shows the depth of the building, while the high noon lighting falls on the top surfaces of the walls and also emphasizes the luminous shadows
Courtesy of Taylor Museum, Colorado Springs Fine Arts Center

of their religion we know that the Mayans were a barbaric people, but they had a marvelous sense of true design, as is evidenced in their sculptural decorations, all of which were carved with stone tools.

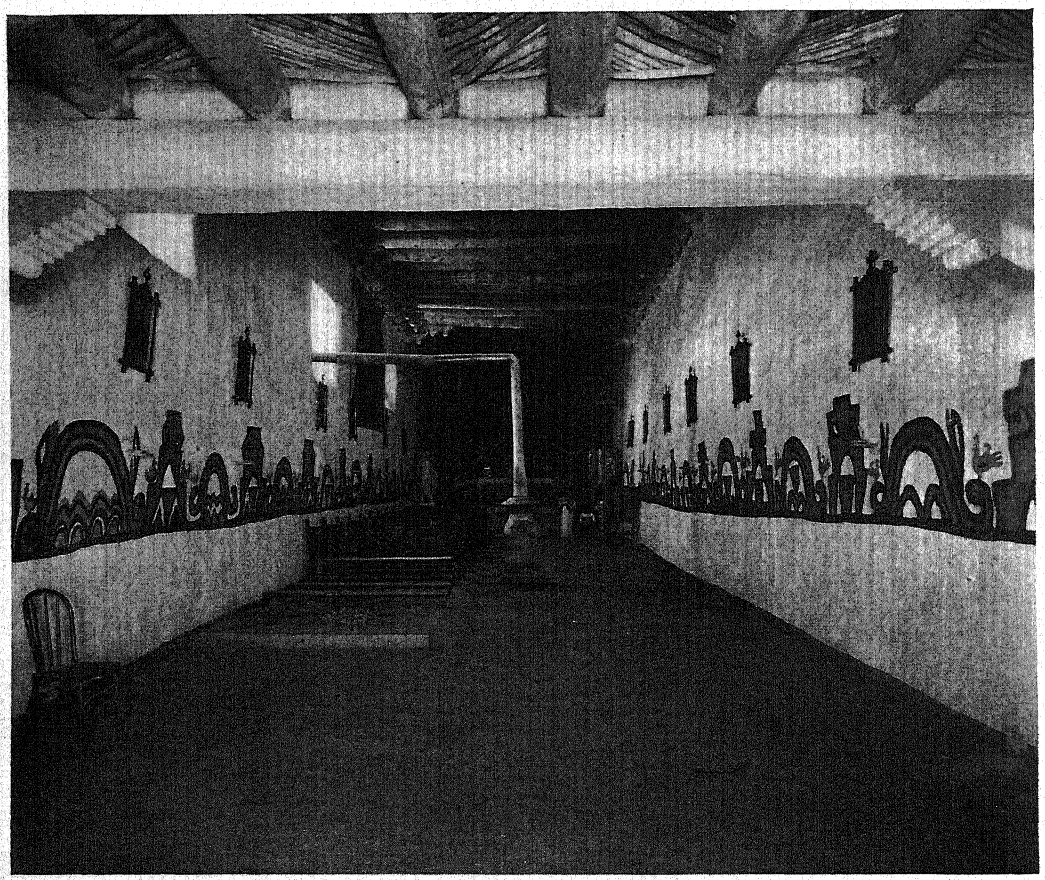
The landscape in which the temples of Chichen Itza are located is uninteresting. It is a flat limestone shelf, with little beauty save for the individual trees and tropical growth of plants. These, however, can be used to great advantage in the decorative treatment of the designs of the photographs. The stone from which these temples were built is a beautiful white limestone, which has gathered a deposit of some kind in the undercuttings, becoming a rich black with the passage of time. This gives a great contrast to some parts of the buildings in the tonal value of the material itself. Add to this an interesting play of light and shade, and the photographer's palette is complete. One is often handicapped by surroundings. Trees may be in the wrong place, another building is too near, or something else is in the way. However, by diligent search some point of vantage may be found which will solve the problem.

Spanish. Today one finds beside these Indian buildings, both in Old Mexico and in New, the architecture of the Spanish Conquerors. In Old Mexico it is, of course, strongly reminiscent of European Spain, though modified by local adaptations. In New Mexico, through the combined efforts of the Spanish priests and their Indian converts, there arose a unique form of architectural expression. In many instances the outer aspects of these churches resemble the great erosions of the desert soil in certain parts of New Mexico. The need of these builders was protection from the heat of summer and from the winds of spring and winter. Their material was the soil on which

they stood, from which they made sun-dried adobe bricks, the walls being plastered with a surface of the same clay. All of the walls were plastered by hand instead of by trowel. This gave the walls a delightful uneven surface—a definite part of their character and appeal.

The early Spanish priests, who were architects as well as contractors, created many large and remarkable churches and missions throughout New Mexico. The fact that necessity demanded thick walls gave these churches a form and bulk that is unique. Were they evenly and straightly plastered with a trowel, they would lose their surface beauty, retaining only that of proportion. For it is the light breaking over the many small, uneven modelings of the great walls which gives them this rich warmth and special quality.

Domestic architecture in New Mexico also has its originality. The same necessity for thick walls in hot weather and windy days makes a cool retreat from the dazzling sun of this Southwestern region. In many Spanish-American villages, in remote parts of this area, one drops back into the 16th and 17th centuries. These natives are far removed from their origin, as well as the influence of our civilization, and they lead simple lives of farming and religious worship. Everywhere one finds churches, some of which are very small in comparison to the great Missions. There were, and still are, many carvers among these Spanish-American people who have made unique figurines of the saints and the Holy Family. These are the distinct expression of a native craft. They play an important part in the churches, often having special "nichos" built in the walls.



LAGUNA MISSION INTERIOR. **Soft natural lighting has here revealed the hand modeling of the walls and the interesting decorations made by the Indians. By using a central position, the lines of perspective indicate the length of the nave**
Courtesy of Taylor Museum, Colorado Springs Fine Arts Center

CONCLUSION

The light of the Southwest has a special quality of its own, and to make photographs that do not give this intense feeling of sunlight is to leave out an integral part of the country. There are, of course, occasional gray days, and these have their value in pictures as well as in the life of the country, but the essence is sunlight.

Wherever man has lived on earth he has left architecture, be it humble hut or magnificent temple. Through his particular need he has erected his dwelling and his shrine in all parts of the earth. From the differences of his needs and beliefs, due to location and to race, has come a vast procession of architectural expressions. Photography, because of its ability to record unusual and fleeting effects, and the rapidity with which negatives can be made, is more capable than any other medium of interpreting for us much of this architectural procession. It remains for photographers of the present and the future to use this wonderful medium to the utmost, with skill and keen vision.

HISTORY OF PHOTOGRAPHY

Beaumont Newhall

Curator of Department of Photography and Librarian, Museum of Modern Art; Author of Photography: A Short Critical History

A well-known historian of photography tells of the step-by-step progress of photographic technic from the first experiments to the latest developments in the color field. Some of the many phases covered are: Early Experiments . . . The Daguerreotype . . . Calotype . . . Collodion Process . . . Famous Wet Plate Photographers . . . Dry Plates and Film . . . Recent Developments . . . Documentary Workers . . . Photo-Reportage . . . High Speed and Color Photography.

See Also Growth of Photography (page 4), Candid Photography, Chemistry of Photography, History of Photography—Motion Pictures

PRACTICAL PHOTOGRAPHY is just over one hundred years old. In 1839 two technics were given to the world—daguerreotypy, direct positives on silvered copper, and talbotypy, or paper positives from paper negatives. Both processes are named after the men who first described them, the Frenchman Daguerre and the Englishman Talbot. While these were the first practical technics, both inventors depended upon the results of earlier experimenters. It is logical to divide these pioneers into two groups—those who discovered the reaction of metallic salts to light, and those who brought the camera into being.

EARLY PHOTOCHEMISTRY

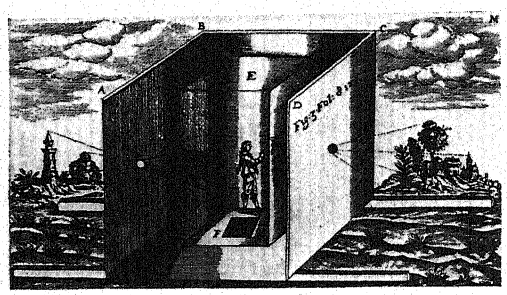
For years it had been noticed that certain metallic salts, particularly those of silver, darkened when exposed to sunlight. It was supposed that this phenomenon was due to the heat of the sun's rays until, in 1727, the German physicist Johann Heinrich Schulze (1687-1744) performed a classical experiment which proved conclusively that the reaction was due to light. He pasted paper letters on a bottle which had been filled with a mixture of chalk and silver nitrate. The mixture blackened on exposure to light, except for those areas directly behind the letters. Upon removing the letters, their shapes, therefore, momentarily appeared as white upon a dark ground until the action of light darkened them to the same shade as the entire mixture. Schulze found it impossible to duplicate this result by the heat of a fire, and concluded that silver salts were sensitive to light alone. It has been argued that Schulze was, in fact, the first photographer and that his record of pasted-up letters was a photographic one. This seems a far-fetched theory. Schulze had no desire to fix an image and he did not push his experiments to the point of rendering the unexposed silver salts insensitive by fixing (see article on *Chemistry of Photography*).

A few years later Schulze's experiment was repeated by Dr. William Lewis in England. Upon the death of this scientist his notebooks, which contained a full description of the experiment, were acquired by the famous potter, Josiah Wedgwood, who also gave employment to Lewis's former assistant as a tutor to his son Tom. Among the products for which the Wedgwood pottery was noted were dinner services decorated with pictures of the castles and country seats of the English nobility. It seems that the sketches for these painted scenes were secured by the aid of the *camera obscura*.

DEVELOPMENT OF THE CAMERA

Photography is but one of the uses to which the optical instrument known as the

camera obscura has been put. Aristotle noted that an image was formed on the inside wall of a dark room (Latin: Camera obscura) by light rays passing through a small hole in the opposite wall. Medieval scientists made use of this phenomenon to study eclipses of the



EARLY CAMERA OBSCURA. Built in the late seventeenth century, this shows a man actually inside the box-like structure, viewing the images as projected on screens through the outside holes

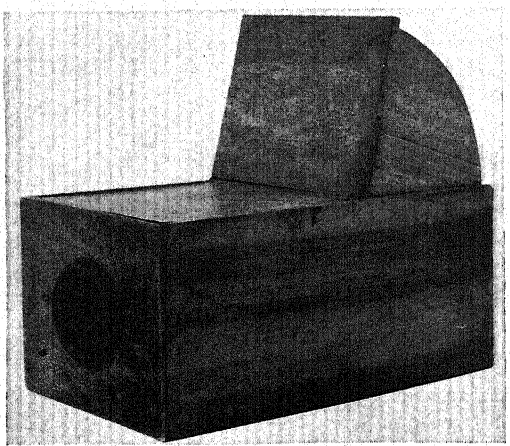
sun with greater ease. Leonardo da Vinci (1452-1519) described the pinhole camera in the pages of his private notebooks, written in secret code. This is the first mention of the camera by an artist, and while there is no evidence that he used the image of the camera to help him in his painting, many artists who followed him did make frequent use of the instrument. This is not surprising when we realize the intense preoccupation of Renaissance artists with perspective, then newly appreciated. In 1553 Giovanni Battista della Porta, after describing a camera, concluded: "This will make it possible for anyone ignorant of the art of painting to draw with the pencil or pen the image of any object whatsoever." The first mention of the substitution of a lens with diaphragm for the pinhole is made by the artist Danielo Barbaro.

These cameras were literally rooms, big enough to get inside. They were sometimes mounted on wheels or carried about on poles, like sedan chairs, or demountable and tent-like. In 1665 the oculist Zahn described a really portable camera. It was a box with a lens at one end and a mirror, set at 45°, at the other end. Over the mirror, on the top of the box, was a groundglass, which was protected with a hinged cover fitted with sides to form a hood when erected. It was, in short, a reflex camera. The user put translucent paper on the groundglass and traced the outlines of the image with a pencil, brush, or pen. Throughout the 18th century cameras of this type were used extensively, especially by unskilled amateurs (see article on *Camera Obscura*).

FIRST TRIALS

Tom Wedgwood (1771-1805), familiar with both the camera and with Schulze's experiments, was the first to attempt to record the camera's image by photochemical means. Together with Sir Humphrey Davy (1778-1829) he began by making contact prints, or shadowgraphs, of natural flat objects on leather soaked in silver nitrate or silver chloride solutions. These prints were not permanent, for the experimenters were ignorant of any fixing process, and all we know of their work is the account published in the *Journal of the Royal Institution* for 1802. In this article the experimenters specifically describe their attempts to use the sensitive material in the focus of a camera, and express regret that they were unsuccessful.

Apparently unaware of the English publication, the Frenchman Nicéphore Niepce (1765-1833) carried out similar experiments a few years later. Using a crude miniature camera—an old jewel box with the lens of a microscope—he made negatives on silver chloride paper in 1816. He did not call his results negatives, however, nor did he recognize them as such. He sent a number of his "gravures" to his brother, complaining of their reversal of tones. Had he been aware of Wedgwood's work he might have made



REFLEX CAMERA OBSCURA. Here is a portable camera obscura, closely resembling the structure of a reflex camera. Collection of A. Gilles, Paris



REPRODUCTION BY NIEPCE. This reproduction of an engraving of Cardinal d'Amboise was made on a heliographic plate about 1827. From the collection of the Royal Photographic Society, London
Photo, The Science Museum, London

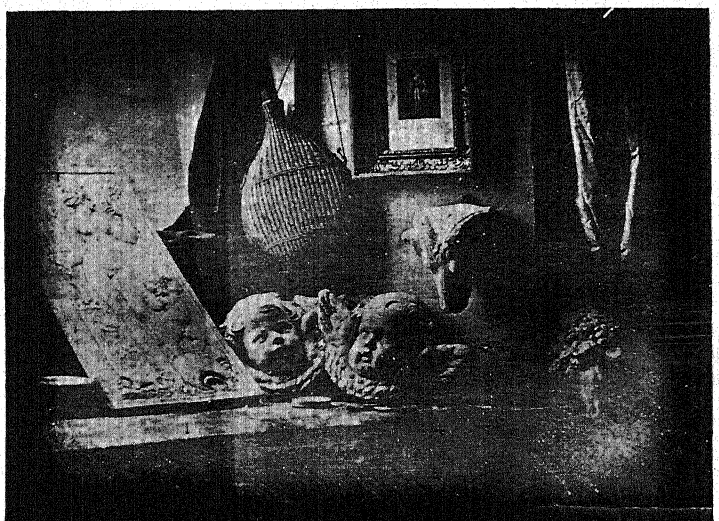
positive prints from his first results, and thus have stumbled on the negative-positive theory. Instead he abandoned the use of silver chloride paper and sought a way to make direct positives.

By 1827 he had succeeded in this quest. Pewter, covered with asphaltum (bitumen of Judea), was exposed behind a translucent drawing or print, or in the camera. It was then bathed in lavender oil, which dissolved only those areas untouched by light. The bare metal areas so revealed were then treated in one of two ways. They could be etched with acid to form a plate which could be inked and printed by the intaglio process (like a copper plate engraving, the commonest example being the visiting card). Or the bare areas, representing shadows (no light), could be blackened with the fumes of iodine. Plates reproducing engravings so made still exist (Royal Photographic Society, London; Niepce Museum, Chalon-sur-Saône, France; Société française de Photographie, Paris). There are no known examples extant of his camera work. However, Robert Hunt, in 1844, described a Niepce plate "taken from nature" as still extant, which offers some proof that the process was a relatively permanent one (see article on *Niepce*).

DAGUERRE

Jacques Louis Mandé Daguerre (1787-1851) was a Parisian scenic artist. On learning about these experiments of Niepce's, he wrote to him, suggesting partnership. These overtures were not received with enthusiasm; not until 1829 did Daguerre succeed in convincing Niepce that a partnership would be to their mutual benefit. They signed a contract, and Niepce handed to Daguerre a written description of his "heliographic" process. Four years later Niepce died.

By 1837 Daguerre produced a satisfactory result with his improvement of Niepce's process. It was a view of the corner of his studio, and this *daguerreotype* is now in the collection of the Société française de Photographie, Paris. Daguerre kept his process entirely secret, and tried to market it through public exhibition of its results. He found it

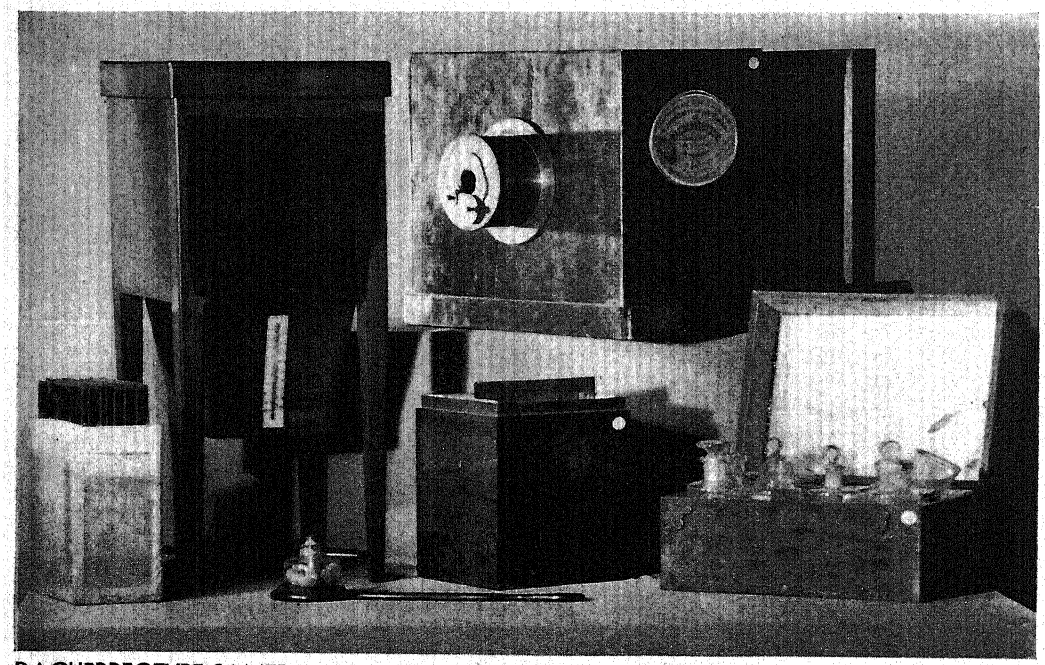


EARLIEST EXISTING DAGUERREOTYPE. A still-life made by Daguerre in 1837. Collection of the Société Française de Photographie, Paris

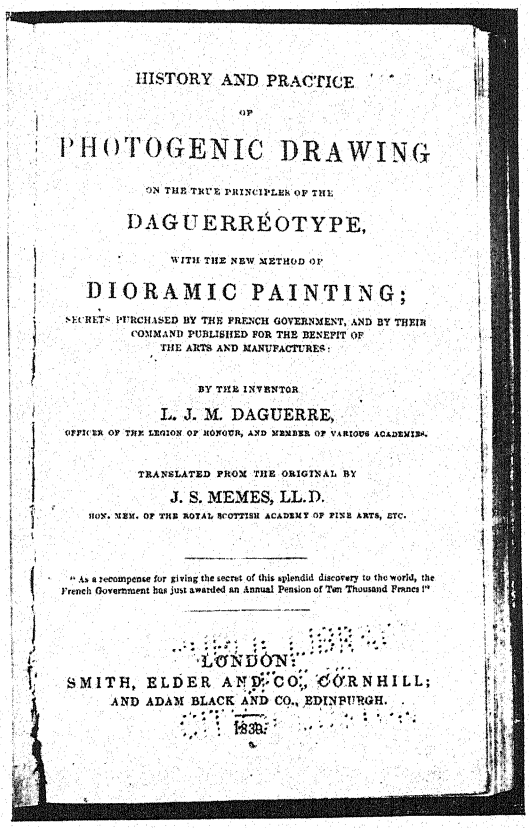
difficult to convince people that his results were not obtained by manual means, and he faced a general skepticism. There had been several scientific hoaxes in the 19th century and there was a universal resistance to new ideas. In an effort to secure royal patronage, daguerreotypes were sent to the crowned heads of Europe. Finally, early in 1839, Daguerre found a friend in the scientific world, the physicist and politician François Arago (1786-1853), who promised to bring his process to the attention of the Academy of Sciences. On January 7 the Academy acted on Arago's suggestion and voted to investigate daguerreotypy with the view of recommending to the government its outright purchase. The curiosity of the scientific and artistic world was aroused by this dramatic announcement and at once there was much speculation on the precise nature of the process.

A committee was formed by the Academy to investigate, in a strictly confidential manner, the technic and the uses of the process. They asked the opinions of scientists and artists. The testimony of the painter Paul Delaroche is characteristic of the enthusiasm roused by those early daguerreotypes. "From now on," he exclaimed, "painting is dead." This exaggeration was typical of the early criticism. The public was enchanted by the amount of detail which was rendered and found it incredible that through a magnifying glass even more details could be made out. Upon the recommendation of the investigating committee, a bill was drawn up for presentation to the government. This was quickly passed by both houses and August 19 was set as the date for the publication of full technical details, in return for which Daguerre and the son of Niepce were to receive annual pensions for the rest of their lives.

Scientists from all over the continent flocked to Paris to learn the secrets of this revolutionary picture-making technic. We read in contemporary newspapers that although the meeting was not held until three o'clock in the afternoon, by one o'clock every seat had been taken and by two several hundred people were gathered outside of the Institut de France. Daguerre himself did not appear. Instead, his champion Arago delivered a somewhat pedantic description of the process. Tension was high among the audience, and within a few days people were taking photographs in the streets of Paris.



DAGUERREOTYPE CAMERA AND APPARATUS. Built in about 1839 by Giroux and sealed by Daguerre as authentic. From the Eastman Historical Collection, Rochester



HISTORY AND PRACTICE

OF

PHOTOGENIC DRAWING

ON THE TRUE PRINCIPLES OF THE

DAGUERREOTYPE,

WITH THE NEW METHOD OF

DIORAMIC PAINTING;

SECRETS PURCHASED BY THE FRENCH GOVERNMENT, AND BY THEIR COMMAND PUBLISHED FOR THE BENEFIT OF THE ARTS AND MANUFACTURES:

BY THE INVENTOR

L. J. M. DAGUERRE,

OFFICER OF THE LEGION OF HONOUR, AND MEMBER OF VARIOUS ACADEMIES.

TRANSLATED FROM THE ORIGINAL BY

J. S. MEMES, LL.D.

HON. MEM. OF THE ROYAL SCOTTISH ACADEMY OF FINE ARTS, ETC.

"As a recompense for giving the secret of this splendid discovery to the world, the French Government has just awarded an Annual Pension of Ten Thousand Francs!"

LONDON:

SMITH, ELDER AND CO., CORNHILL;

AND ADAM BLACK AND CO., EDINBURGH.

1839.

DAGUERRE'S MANUAL. This is the title page of the first English edition. The quote following the translator's name reads: "As a recompense for giving the secret of this splendid discovery to the world, the French Government has just awarded an Annual Pension of Ten Thousand Francs!" ***Courtesy Boston Public Library***

THE DAGUERREOTYPE PROCESS

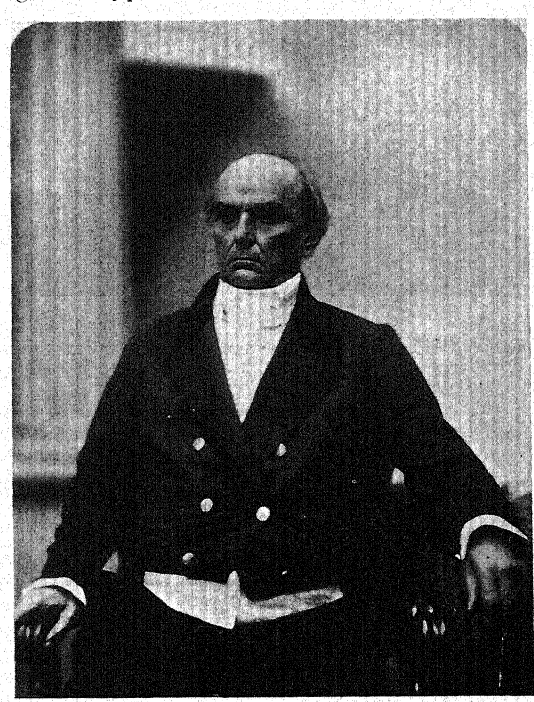
Daguerre's process was not a negative-positive one. A highly polished silvered copper plate was placed in a closed box over solid iodine particles which, by the action of their fumes, converted the surface into light-sensitive silver iodide. This plate was exposed in a camera fitted with an achromatic meniscus lens, working at a fixed stop of about f/15. Here is an actual exposure table, taken from an 1840 manual:

	Summer	*Winter*
Bright sunlight		
White subjects	4- 5- 6 minutes	8- 9-10 minutes
Colored subjects	8- 9-10 minutes	12-15-17 minutes
Diffused sunlight		
White subjects	12-15-18 minutes	25-30-40 minutes
Colored subjects	20-25-30 minutes	40-50-60 minutes

After exposure, the plate was developed by placing it at an angle of 45° over heated mercury, washed, and fixed in hot sodium chloride or sodium thiosulfate solution. The result was a mirror-like picture of great brilliance and definition, but the result was unique and the image could be duplicated only by re-photographing the original. This was a distinct drawback, and was the reason why daguerreotypes began to become extinct with the introduction, in 1851, of glass negatives (see article on *Daguerreotype*).

SPREAD OF DAGUERREOTYPY

The booklet which Daguerre wrote describing the process became a best seller. It was issued in no less than twenty-six editions and translations within the five months between August and December, 1839. The description was so complete that anyone with sufficient mechanical skill could build his own camera and secure practical results. The camera built in Philadelphia in 1839 by Joachim Bishop, an instrument maker, for Joseph Saxton, is still in working order in the Franklin Institute in Philadelphia; in 1939, to commemorate the centenary, daguerreotypes were made with it. For some



DANIEL WEBSTER. A daguerreotype by Southworth and Hawes, 1851. These two Boston photographers represent daguerreotypy at its height. From the Collection of Edward S. Hawes, Boston

reason America became the adopted home of daguerreotypy. The greatest progress was made in this country and even Europeans were forced to acknowledge the superiority of American daguerreotypes. Indeed, photographic portraits were taken here before the eventful year 1839 had run its course; they are probably the earliest in the world.

Improvements. The exposure time of the primitive process was too great, however, to make portraiture generally feasible. Immediately attempts were made to decrease this factor through optical and chemical improvements. In 1840 a portrait lens of aperture f/3.6 was designed by Josef Petzval (1807-1891) and built by Voigtländer in Vienna. An additional element was supplied which could be substituted for the front element of the portrait combination to make a slower but better corrected landscape lens. In this same year the sensitivity of the daguerreotype plate was increased by a secondary fuming with bromine before exposure, a technic first published by John Frederick Goddard in London. (Curiously enough Dr. Paul Beck Goddard of Philadelphia had independently worked out a similar hypersensitizing technic somewhat earlier, but had failed to publish it.) To make the image more brilliant and visible, gold toning was introduced by Hippolyte-Louis Fizeau (1819-1896). His formula (gold chloride, hypo, and water) has remained in use up to the present day for the toning of positives. These improvements brought about a great increase in the use of daguerreotypy. It became fashionable to have one's portrait made and soon competition forced the price down to a point where even the humblest workman could have pictures of his relatives and friends. The business of miniature painting was almost entirely wiped out by this newer technic and there is a satirical French lithograph captioned "Daguerreotypomania" which includes a gallows bearing the sign "Reserved for Messieurs the Engravers."

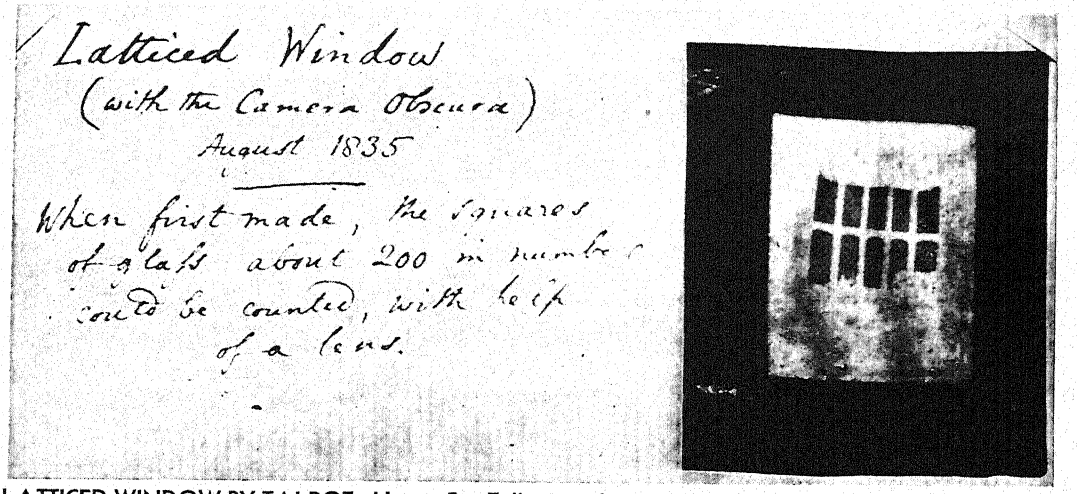
TALBOT AND PAPER NEGATIVES

But the daguerreotype process was not the only photographic technic invented in 1839. The news of its recognition by the French Academy came to the Englishman William Henry Fox Talbot (1800-1877) as a sudden shock. "I was placed in a dilemma scarcely to be paralleled in the history of science," he wrote later. Independently and without knowledge of the work of either Daguerre or Niepce he had worked out a scheme of making pictures by the action of light. His first successful experiments dated back to 1835, but these he had not published, as he desired to make many improvements. Fearing that Daguerre's process might prove to be identical with his own and that his labors would be completely lost, Talbot sent some examples of his "photogenic drawings" to the Royal Institution, where they were exhibited. On January 31, 1839, a letter was read to the Royal Society, describing in general his technic and on February 21 he divulged complete details (see *Talbot* and *Calotype* articles).

Writing paper was washed alternately with a solution of silver nitrate (diluted 1:6 or 1:8) and with a saturated solution of sodium chloride (common salt). These chemicals reacted to form light-sensitive silver chloride in the fibers of the paper. In his earliest experiments, dating back to 1834, he placed leaves, lace, or translucent drawings on this sensitive paper, which he exposed to sunlight. These shadowgraphs were fixed in a saturated solution of sodium chloride. The result was, of course, a negative. These negatives were printed in positive by repeating the process. Thus was discovered the negative-positive principle, the foundation of photography as it is known today.

Among the photogenic drawings exhibited at the Royal Institution were several negatives which had been made in a camera obscura as early as 1835. One of these is still in existence in the Science Museum in London. The exposure was very long and the results were exceedingly primitive.

Talbot took great pains to publicize these experiments and he sent copies of the papers read to the Royal Society to scientists all over the continent. His friend Sir John Herschel (1792-1871) suggested to him the use of sodium thiosulfate, which he had discovered in 1819 and named sodium hyposulfite (whence "hypo"), as a means of dissolving the unexposed silver salts. It was Herschel, too, who proposed the terms



LATTICED WINDOW BY TALBOT. Here is Fox Talbot's earliest paper negative, made in 1835. The legend reads: "Latticed Window (with the Camera Obscura) August 1835—When first made, the squares of glass about 200 in number could be counted, with help of a lens." In the collection of The Science Museum, London
Courtesy of Museum of Modern Art

"negative" and "positive," and it seems likely that he coined the word "photography," which has passed into every language (see article on *Herschel*).

In 1841 Talbot patented an improved paper negative process which he named *calotypy*,* from the Greek words meaning beautiful and picture. The advantage of this new technic was an increase in sensitivity. "To take portraits from life I prefer to use a lens whose focal length is only three or four times greater than the diameter of the aperture [i.e. f/3, f/4]. Under a serene sky, but without sunshine, the image is generally obtained in one half a minute or a minute."

*Not to be confused with *collotypy* or *kallitypy*, names of quite other processes.

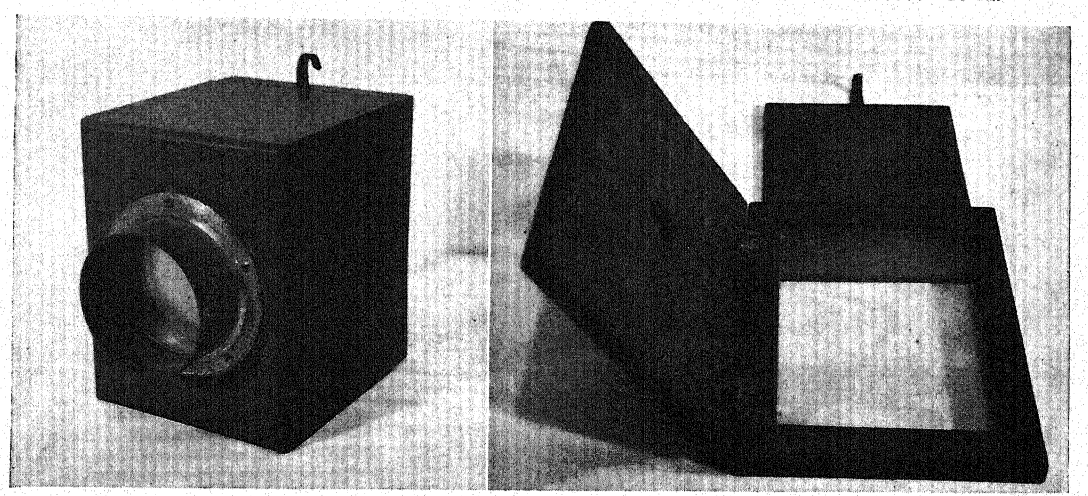
THE CALOTYPE PROCESS

To make a calotype, one side of a piece of paper is washed with

Silver nitrate	100 grains
Distilled water	6 oz.

and dried. It is then dipped in

Potassium iodide	500 grains
Distilled water	20 oz.



FOX TALBOT'S CAMERA. At left is the complete camera, used by the inventor of the calotype in about 1840 and found in the Collection of the Royal Photographic Society, London. At right is a detail of the paper holder. The paper was placed in contact with the glass and the hinged back closed. The image was viewed through the round peep hole

for 1 to 2 minutes, washed in water, and dried. A quantity of this "iodized" paper may be prepared at once. It is sensitized for use by being washed over with a mixture of equal volumes of Solutions *A* and *B*, the mixture being known as "gallo-nitrate of silver."

A.	Silver nitrate.....	100 grains
	Distilled water.....	2 oz.
	Acetic acid.....	1/6 volume
B.	Gallic acid (crystallized)	saturated solution

The paper is dried before exposure in the camera.

After exposure, the latent image is developed in the same gallo-nitrate of silver solution used for sensitizing. The negative is fixed in either

Potassium bromide.....	100 grains
Water.....	8 or 10 oz.

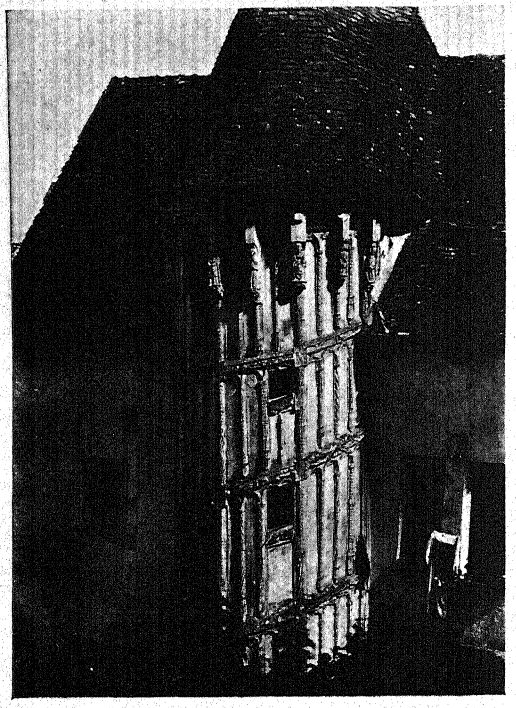
or

Sodium thiosulfate (hypo)	1 part by weight
Water.....	10 parts by weight

Heat to nearly 212° F. for use.

It is then washed, dried, and waxed to render it translucent.

The original photogenic paper was used to make prints from these negatives because the image of the calotype was a disagreeable olive tone.



LE SECQ CALOTYPE. This interesting architectural photograph is of the Stair Tower at Chartres, made in 1852 by Henry Le Secq. Collection of the Museum of Modern Art, New York

SPREAD OF CALOTYPY

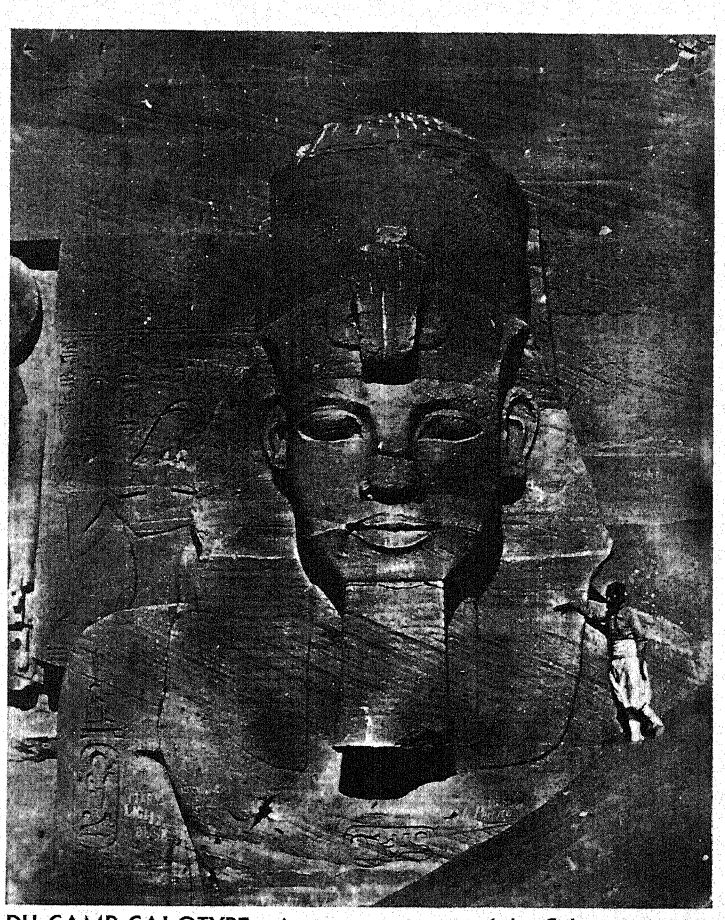
The first serious use of the calotype process for artistic purposes was made by the Scottish painter David Octavius Hill (1802-1870) in collaboration with the chemist, Robert Adamson (1821-1848), who had learned the technic from Sir David Brewster, one of Talbot's friends. Hill, in 1843, undertook a commission to paint a group portrait commemorating the foundation of the Church of Scotland. In order to gather data for the five hundred heads which he had to incorporate in this picture, he turned to photography and produced some remarkable portraits. In 1848 Robert Adamson died, and Hill's photographic work after this date is of relatively little significance. Many of these portraits of famous Scottish people were published in album form, presumably for the strictest private circulation (see article on *Hill*).

The first actual book illustration with photographic prints was Fox Talbot's *The Pencil of Nature* (1844). "The chief object of the present work," wrote Talbot in the preface, "is to place on record some of the early beginnings of a new art." He gave a careful account of the discovery of his processes and included samples of various uses to which photography could be put. A number of remarkable prophecies are to be found in the text of *The Pencil of Nature*, among them a theoretical description of photography by the invisible rays.

Talbot's action in taking out a patent for the calotype process hindered the development of the art in England. In 1849 the brothers Langenheim took over the American agency for Talbot, but they had no success whatever in selling licenses, as the majority of American photographers preferred daguerreotypy. In France the patent rights were completely disregarded and several improvements were made by Louis-Désiré Blanquart-Evrard (1802-1872), who learned the process indirectly from a pupil of Talbot. In 1851 Blanquart-Evrard described a method of making paper positives by development. Up to that time prints had all been made with slight modifications

of Talbot's original "photogenic paper." This required a considerable exposure to sunlight; it was too time-consuming for mass production. Blanquart-Evrard adapted Talbot's negative paper for positives, by finding a process for controlling the tone of the silver image. To a solution of the iodide and the cyanide of potassium he added albumen in the form of milk whey and egg white. Paper was soaked in this preliminary bath and then sensitized in a silver nitrate solution. After a short exposure, the latent image was developed in gallic acid.

At his "Photographic Printing Establishment" in Lille, Blanquart-Evrard produced hundreds of prints for the illustration of books. He gave employ to some of the finest architectural photographers in the entire history of this branch of photography. Large negatives—often over 16 by 20 inches—were regularly produced by Henry Le Secq (1818-1882), Charles Marville, Gustave Le Gray (d. 1882), and Charles Nègre (1820-1880). Perhaps his most notable publication was an album of prints from negatives of Egypt and the Near East, made between 1849 and 1851 by the novelist Maxime Du Camp (1822-1894).



DU CAMP CALOTYPE. An impressive view of the Colossus of Abu-Simbel, made in Egypt about 1850 by Maxime Du Camp. This was taken from his book, *Egypte, Nubie, Palestine et Syrie* which was published in 1852. From the Eastman Historical Collection

GLASS NEGATIVES

But in comparison with the daguerreotype even the finest calotypes lacked detail and finish, for the fibers of the paper negative were reproduced together with the silver image. The solution of the problem of combining the duplicating feature of the negative-positive process with the detail of daguerreotypy was finally solved, after many partial successes, with the introduction of the collodion technic by Frederick Scott Archer (1813-1857) in 1851. This "wet plate" process entirely revolutionized photography, forcing into obsolescence both daguerreotypy and calotypy.

The Collodion Process. As described in Robert Hunt's *Manual of Photography* (5th ed., 1857), a saturated solution of potassium iodide is prepared by adding to 1 ounce of alcohol an excess of potassium iodide and of silver iodide and decanting the liquid when precipitation has taken place. This is added to collodion in proportions which the photographer must determine by experiment. Hunt suggests 30 minims of the iodide solution to 1 ounce of collodion. The mixture is poured over one side of a glass plate. Immediately before use the plate is "excited" by immersion in the solution:

Silver nitrate	30 grains
Distilled water	1 oz.

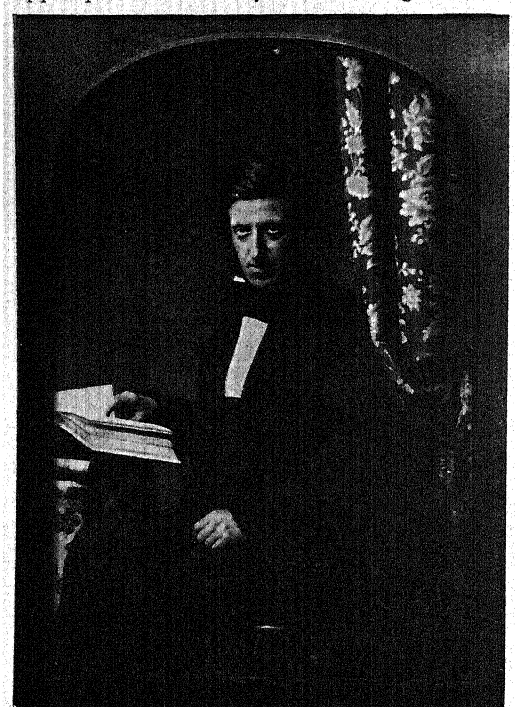
While still wet it is exposed in the camera for about two minutes.

Development follows immediately, before the silver salts have crystallized out, in

Pyrogallic acid	5 grains
Distilled water	10 oz.
Glacial acetic acid	40 minims

by deftly pouring a small amount over it. It is fixed after washing by pouring hypo or potassium cyanide solution over it until the image has cleared. It is then washed and dried.

This peculiar technic made it necessary for the photographer to have a darkroom always available. While this was no particular problem to the portrait photographer, the man working in the field was forced to carry a darkroom with him. Some photographers had a wagon specially fitted up, while others had more portable constructions. These were either tent-like, big enough for the photographer to get inside, or else they were similar to a changing bag, in which the photographer inserted his hands or even the upper part of his body. The one great advantage of the collodion process was its remarkable definition and fine grain. The process is still used in the photoengraving industry for the highest class reproduction of line copies.



FREDERICK SCOTT ARCHER. A collodion portrait of the inventor of the collodion process—taken in 1855. Collection of The Royal Photographic Society, London
Photo, The Science Museum, London

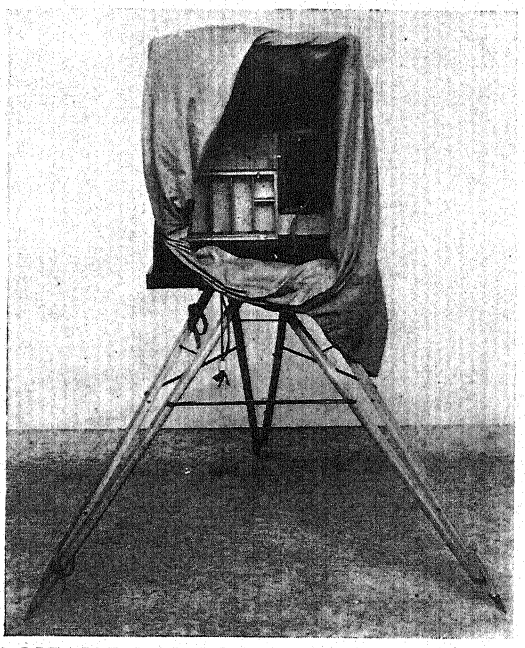
Ambrotype and Tintype. In America, where daguerreotypes retained their popularity, a modification of the wet plate process was used to make cheap imitations of daguerreotypes. A thin negative was bleached so that the silver deposit was light in color. The back of the plate was painted black, and this background showed through the clear glass of the shadows. The descendant of these *ambrotypes* is the ferrotype or tintype, which is now to be found practised by street photographers and in amusement parks.

LEADING WET PLATE WORKERS

Fenton and Brady. Despite the cumbersomeness of the technic, the first documentation of battlefields was by the collodion process. Roger Fenton (1819-1869), first secretary of the Photographic Society of London (later known as the Royal P. S.), went to the Crimea in 1855 with a wagon fitted up as a darkroom. In 1861, at Bull Run, Matthew B. Brady (1823-1896) began his extensive records of the American Civil War. Action photography was out of the question, where exposures were measured in seconds, but the pictures that Brady and his assistants made of the desolation and ruin of campaign grounds almost before the smoke of battle had cleared are no less effective. As Brady wrote in his catalog of war views, they "represent 'grim-visaged' war exactly as it appeared." The objectivity of these photographs is all the more remarkable when it is realized that before the war Brady was the most fashionable portrait photographer to New York and Washington society (see article on *Brady*).

Brady was followed on the battlefield by others, notably his former assistant Alexander Gardner (1821-1882) and T. H. O'Sullivan (d. 1882). Gardner published 100 silver prints from his own negatives and those of other workers in the two-volume *Photographic Sketch Book of the Civil War.*

William Henry Jackson. At the close of hostilities these men followed the Army engineers West. Several were employed by



PORTABLE DARKROOM. Here is the type of equipment necessary for preparing and developing collodion plates in the field. Used about 1870. From the Collection of The Science Museum, London

the Union Pacific Railroad to document the construction of the transcontinental line. Others explored the unknown frontier land; their records were responsible in no small measure for the creation of our National Park System. The Rocky Mountain area was photographed extensively by William Henry Jackson, the dean of American photographers.

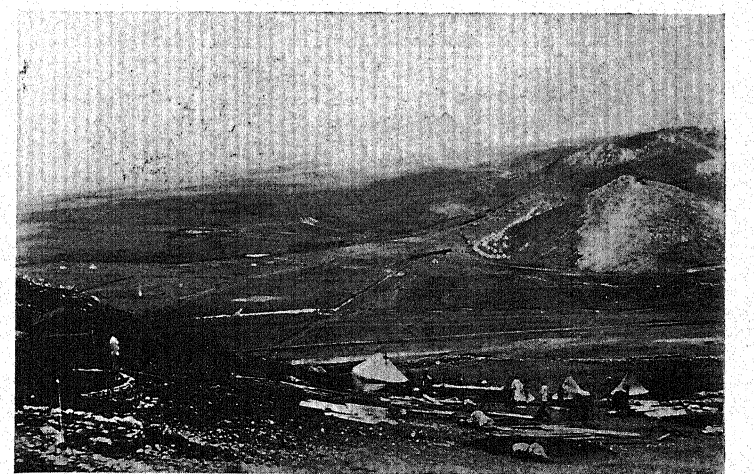
Disderi. The new process simplified portraiture: not only was the exposure shorter, but unlimited copies could be made. The mass production of small portraits which, from their size, were called visiting cards (cartes-de-visite) was introduced by André-Adolphe-Eugène Disderi (1819-1890?), court photographer to Napoleon III, in 1854 (see *Carte de Visite* article). Sitters were posed alike, and eight exposures were made on one plate, by operators working at top speed. From the multiple negative one print was made. The eight poses were then cut apart and pasted onto the small cards which give this style of portraiture its name. Disderi's technic was widely imitated; the phrase "carte-de-visite" entered many languages. Yet despite the adoption of mass production, one should not conclude that all portraiture done by the collodion process was of inferior quality. Nadar and Cameron were working at that time.

Nadar. Nadar (pseudonym of Gaspard Félix Tournachon, 1820-1910) began his portraiture with the daguerreotype. His studio in Paris became a fashionable meeting place, and his negatives, together with those made later by his son Paul, form a magnificent record of the most famous artists, musicians, and literary figures of the last half of the 19th century. He pioneered in other fields, being the first to photograph from a balloon (1856) and by the light of an electric arc (1858) (see article on *Nadar*).

Mrs. Cameron. Julia Margaret Cameron (1815-1879) was not a professional. A friend of Lord Tennyson and of other literary figures in England, she took up photography late in life as a way of recording the members of her distinguished circle. She made a virtue of technical difficulties; her portraits are purposefully unsharp (see *Cameron* article).

PICTORIALISM

In her use of soft focus Mrs. Cameron followed—probably unknowingly—precepts



CRIMEAN WAR PHOTOGRAPH. Roger Fenton, one of the first of the battlefield documentarians, took this long view of Balaklava, 1854. From the Barthélemy Collection, Paris

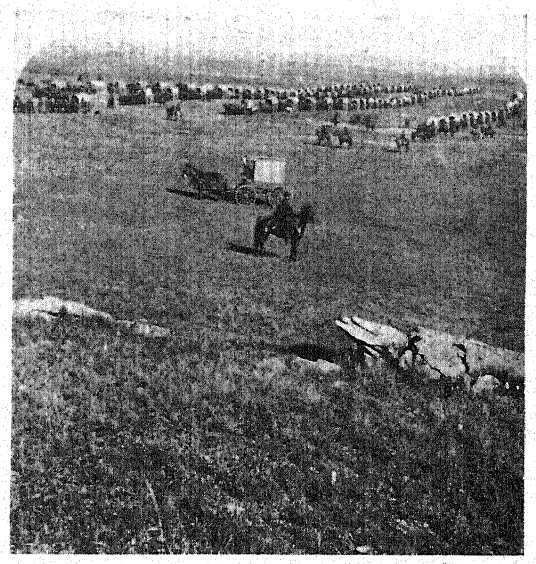


BRADY PORTRAIT OF HORACE GREELEY. A superb portrait of the *New York Tribune*'s founder. This is one of the many portraits (collodion) taken by Matthew B. Brady. From the U. S. Army Signal Corps Files

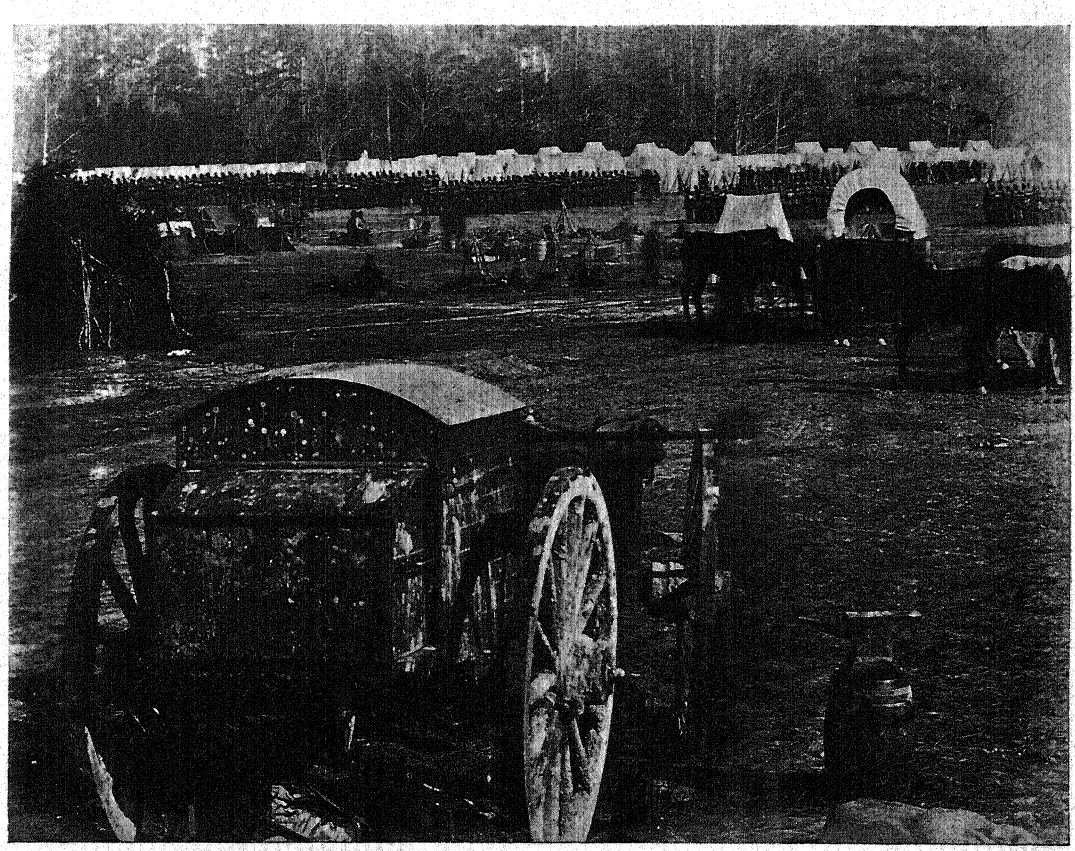
laid down by the miniature painter Sir William Newton (1785-1869) in his lecture to the Photographic Society in 1853. He pointed out that needle-sharp photographs were not evidence of artistic skill, and he pleaded for the deliberate use of slight diffusion in focusing. Discussion of the relative esthetic value of sharp and diffused photographs has continued since that day. The controversy was inevitable; the desire to "raise photography to an art"* brought with it a desire to find methods of controlling the photographic process to eliminate unwanted details and to emphasize significant passages.

Control Methods. In addition to focusing control, the negative could be retouched after development, and the printing process could be manipulated. Retouching began

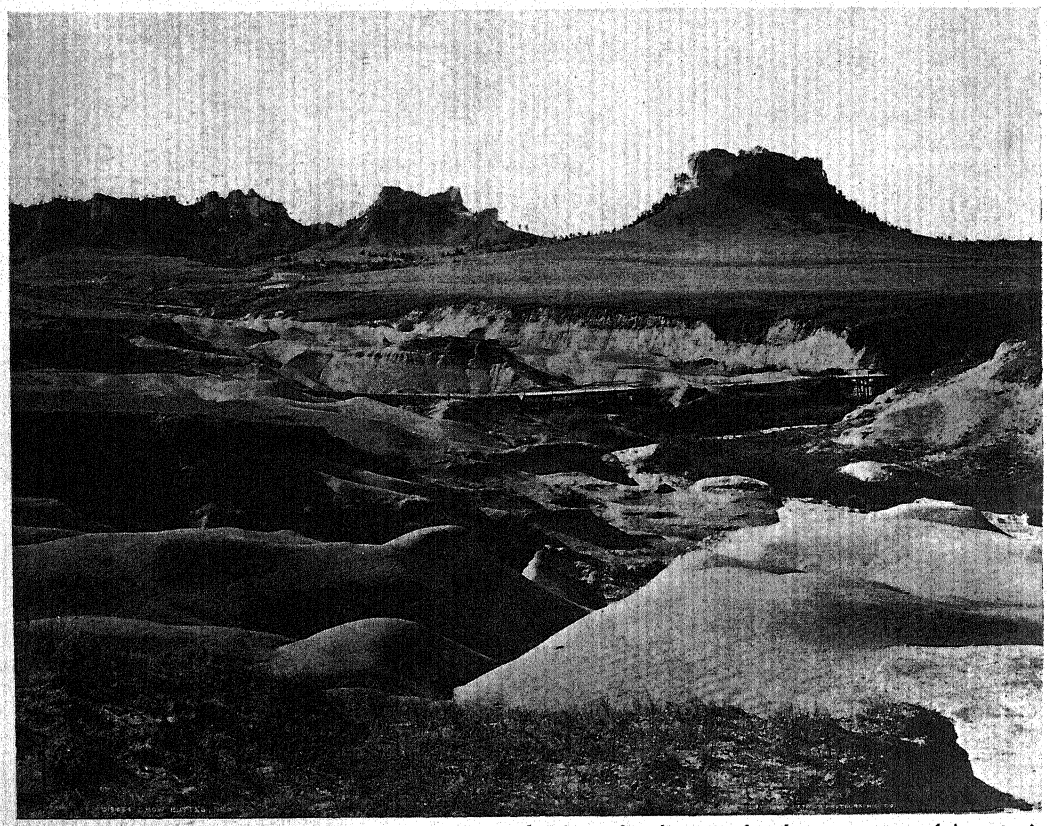
*A caricature by Honoré Daumier shows Nadar—whose fame as an aeronaut rivalled his reputation as a photographer—standing in the gondola of a balloon photographing the scene below. The caption reads: "Nadar Raising Photography to the Height of an Art."



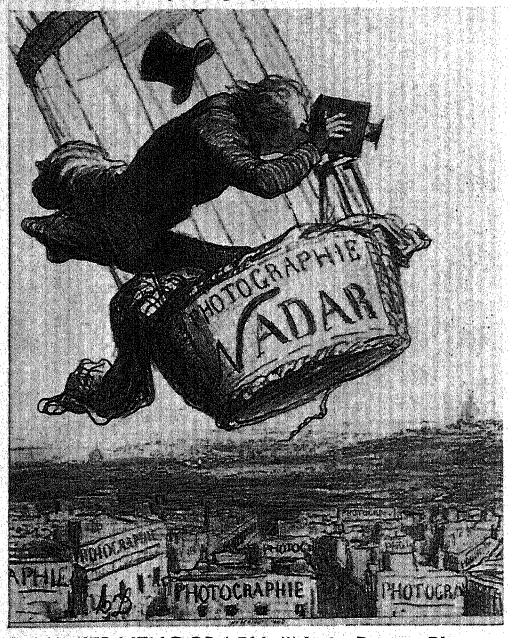
HISTORIC STEREOGRAPH. Custer's Expedition to the Black Hills, taken in 1874 by the frontier photographer, W. H. Illingworth. Collection of Dr. Robert Taft



INSPECTION OF TROOPS, CUMBERLAND LANDING. By Wood and Gibson, this Civil War scene was taken at Paumunkey, Virginia, and reproduced in Gardner's *Photographic Sketch Book of the War.* Print from a collodion negative in the Collection of the Museum of Modern Art, New York



CROW BUTTES, NEBRASKA. William Jackson was a leader in the photographic documentation of America's frontier and photographs such as this were greatly responsible for the establishment of national parks

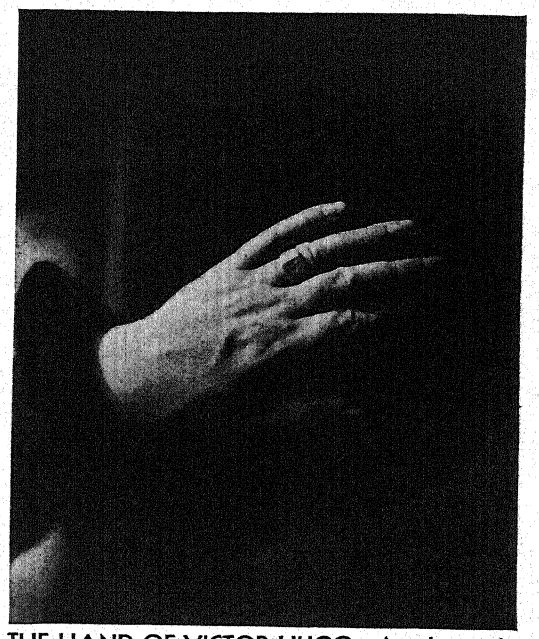


DAUMIER LITHOGRAPH. "Nadar Raising Photography To the Height of an Art." Collection of The Metropolitan Museum of Art, New York

early in photography; a Hill negative dated 1845 is heavily retouched. But it was not universally adopted until Franz Hanfstaengl (1804-1877) exhibited a "straight" and a retouched portrait at the Paris Exposition Universelle of 1855. It was at once adopted by Adam Salomon (1811-1881), and introduced by him to England. In 1861 Salomon visited H. P. Robinson (1830-1901), who eight years later wrote *Pictorial Effect in Photography*, a manual on composition in which Burnet's famous academic treatise for painters was simplified for the use of photographers. The manual appeared in many editions, and was widely imitated. Robinson excelled in "combination printing," using several negatives for one print. He seldom went to nature, but preferred to fabricate natural settings in his studio. He even made a brook, fed from his darkroom drain! His pictures were anecdotal to the extreme, reminiscent of the Royal Academicians' paintings of the day. More famous as a

technician was the Swede O. G. Rejlander (1813-1875) who worked in England. His moralistic *The Two Ways of Life* (1857) was made from *thirty* negatives. A copy was bought by Queen Victoria, herself a photographer of amateur status.

There were comparatively few amateur photographers in the days of the wet plate. The technical demands were great, and it was necessary to keep in constant practice lest one lose one's skill. Among amateur production the photographs of the French poet Auguste Vacquerie (1819-1895) and Charles Hugo (1826-1871) stand out. They accompanied Victor Hugo on his exile to Jersey and documented the great writer's life and environment in a series of remarkable photographs. Their emphasis on detailed views, or close-ups, is a remarkable prophecy of the future development of photographic vision.



THE HAND OF VICTOR HUGO. A calotype by Charles Hugo, from the Eastman Historical Collection, Rochester

DRY PLATES

The search for some way to eliminate the messy technic of the wet plate process was



FADING AWAY. This combination print from collodion negatives (and embellished with a poem by Shelley) was made by Henry P. Robinson in 1858. Collection of Museum of Modern Art, New York



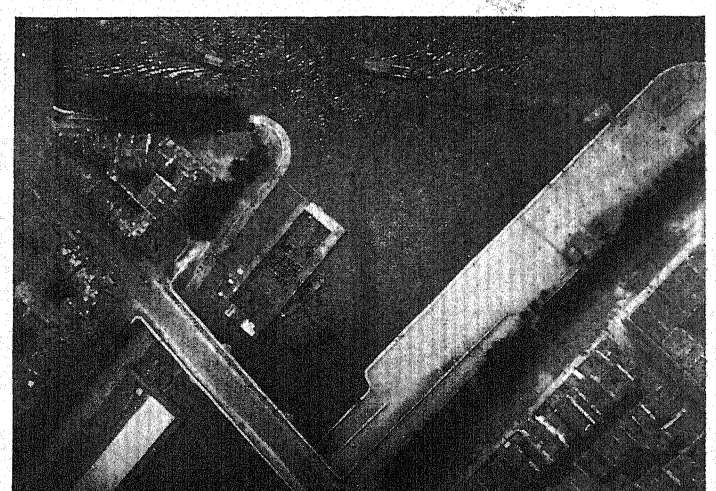
MAGAZINE SELLER. An exposure of between 1/20 and ¼ second was used by Paul Martin in taking this photograph of a Ludgate Circus magazine seller in London (1893-96). DATA: Fallowfield "Facile" camera, rapid rectilinear lens, 3¼ x 4¼ dry plate, 1/20 to ¼ second, f/10.9, modern print from original negative. Collection of The Museum of Modern Art, New York

pursued with great zeal. In 1864 B. J. Sayce (d. 1895) and W. B. Bolton (1848-1899) made dry collodion emulsion plates by coating the sensitized collodion with tannic acid which prevented the crystalization of the silver salts. But this plate was too slow except for landscape work. In 1871 an English physician and amateur photographer, R. L. Maddox (1816-1902), described in the *British Journal of Photography* the use of gelatin as a means of fastening the sensitive silver salts to the glass surface. To a solution of cadmium bromide and gelatin, silver nitrate was added. This was spread on glass. In 1873 plates so prepared were put on the market by Burgess, and in the same year a "sensitive pellicle" was patented by Richard Kennett. This was the prepared emulsion sold in such a form that the photographer could spread it himself upon the plate. It was found that these dry plates were not only more convenient than the older wet plates, but also that their speed was radically increased—to such a degree indeed that photographers found it difficult to prevent overexposure.

It must be remembered that at this time instantaneous exposures were extremely rare, and that most photographers did not own any type of shutter, relying simply on the lens cap to control exposure. With the dry plate, instantaneous exposures at once became possible and the camera was freed from the tripod. This brought about a virtual revolution in photography. The process became much simpler and amateurs could buy plates ready-made, and could develop them at will. They could take pictures of moving objects. A great number of hand cameras were devised which, because of their ease of operation, were called "detective" cameras. Devices were worked out for changing the plates rapidly, permitting more exposures within a given period of time.

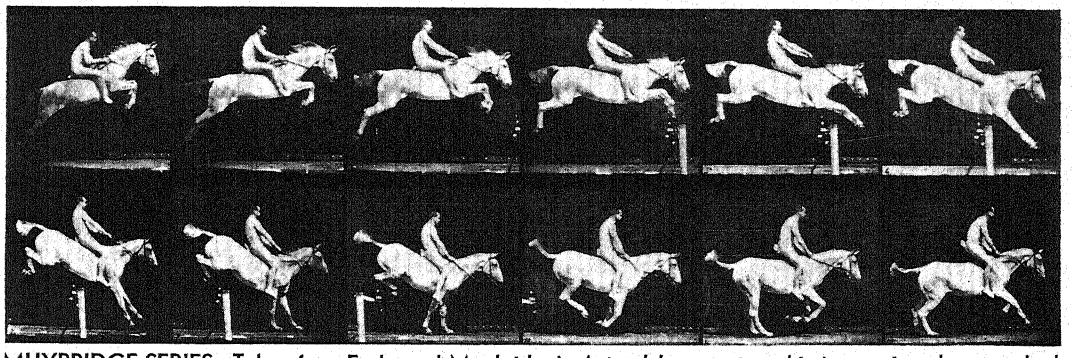
LATER DEVELOPMENTS

Action Photography. Before the perfection of the dry plate, experiments had been made



AERIAL PHOTOGRAPH. Taken in 1886 by Tissandier, this shows a section of Paris. In the Eastman Historical Collection

in the photography of action. Eadweard Muybridge (1830-1904) in 1872 attempted to photograph the gallop of a horse for Leland Stanford in California (see article on *Muybridge*). But the wet collodion plate was unable to record, even under the dazzling California sun, more than a faint, barely recognizable image. Five years later he repeated the experiment, using a battery of cameras



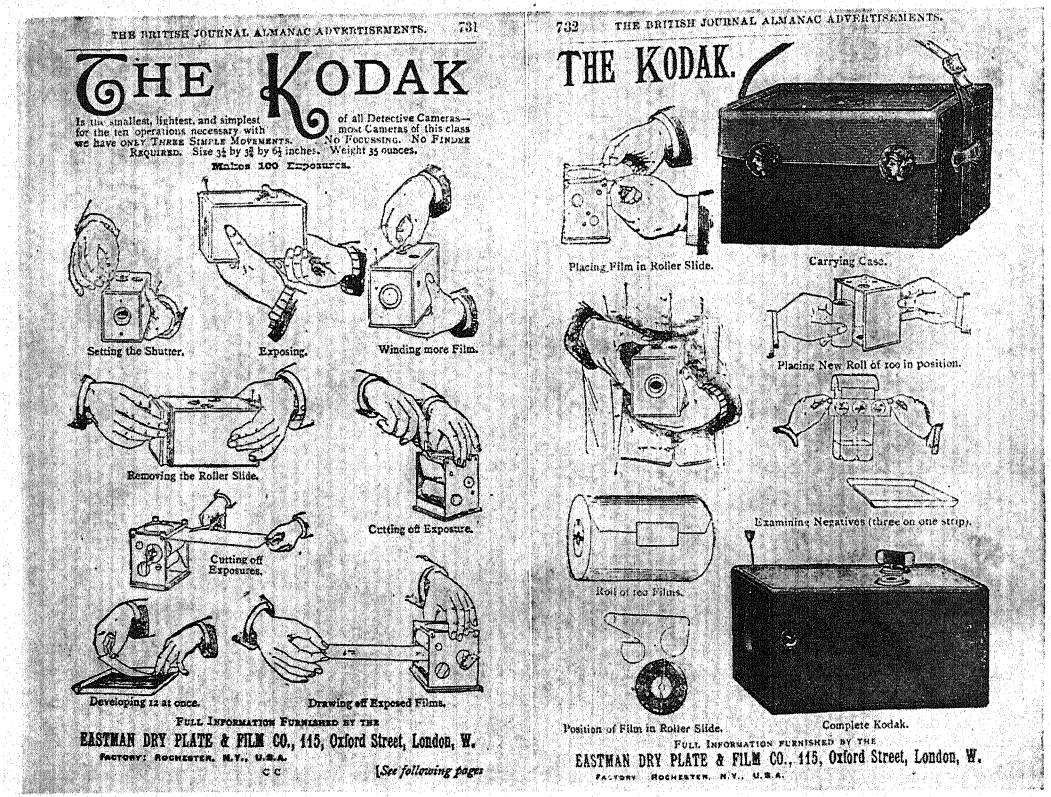
MUYBRIDGE SERIES. Taken from Eadweard Muybridge's *Animal Locomotion,* this is a series photographed in about 1887. Made up of 12 exposures on dry plates in 12 separate cameras. From The Museum of Modern Art, New York

past which the subject ran. The shutters were tripped by breaking strings stretched across the track. These were *multiple* photographs, showing consecutive phases of action. Drawings made from the negatives, assembled to form a series, were published in scientific magazines. The French scientist Étienne Jules Marey (1830-1904), seeing these, asked the editor to put him in touch with Muybridge, as he himself had been conducting researches into the gait of animals. The two met when, in 1881, Muybridge went to Paris. Marey improved on the American's technic, designing a camera, the photographic rifle, which took twelve successive exposures on sections of a revolving dry plate. Muybridge continued to use a battery of cameras and with dry plates and electrically-synchronized shutters he produced a monumental series of folio plates published by the University of Pennsylvania in 1887. The work of Muybridge and of Marey was a step in the direction of the moving picture; the individual pictures which they took being equivalent to the frames of a film. Edison freely admitted that his *Kinetoscope* was based on the work of these experimenters. (See *History of Photography—Motion Pictures*). For his work, Edison used roll film which, though not invented by George Eastman (1854-1932), was made commercially practical by his ingenuity.

The Roll Film. In 1888 Eastman had marketed the first Kodak. This camera did not accept plates; instead a roll of paper spread with emulsion was loaded into it, at the factory. Each such loading was sufficient for one hundred exposures and when the final shot was taken, the entire camera was returned to the factory where the emulsion was developed, stripped from the paper, and printed. The camera was then loaded and sent back to the photographer. A year later transparent flexible film was patented by Eastman. The delicate operation of stripping the emulsion was no longer necessary; photographers could load their own cameras and turn the exposed film over to a commercial firm for processing. Thus was begun a new era in photography, summed up by the Kodak slogan "You Press the Button, We Do the Rest."

SCIENTIFIC THEORY AND ESTHETIC REACTION

Hurter and Driffield. Much of the guess work of photography was eliminated by the advent of prepared plates and films, but the nature of the reaction of silver emulsions to light and the relation between exposure and development were not understood until in 1890 Ferdinand Hurter (1844-1898) and Charles Vero Driffield (1848-1915) published their classic experiment, in which they showed that exposure controlled density and development controlled contrast. For given subject brilliancy relationships there were



THE KODAK. This advertisement from *The British Journal Photographic Almanac* of 1889 gives detailed instruction for the operation of "the smallest, lightest, and simplest of all Detective Cameras"

optimum degrees of development which, in turn, were controlled by the character of the developer, its temperature, and the time it was allowed to act. Thus was conceived the "time-temperature" development technic so common today (see article on *Sensitometry—Hurter and Driffield*).

There was a general reaction to the teachings of these scientists. Photographers clung to experience and continued to develop by inspection. One amateur, however, was at once influenced by the scientific truths which seemed to upset his photographic world. His name was P. H. Emerson.

Naturalistic Photography. P. H. Emerson (1856-1936), a leading pictorial worker, had stirred up controversy in England with his doctrine of "naturalistic photography." This was a reaction to the artificiality of the work of H. P. Robinson and his followers. Emerson held that a photograph should imitate human vision, and he went a step beyond Sir William Newton in the use of focusing as a control. In his book *Naturalistic Photography* he asked photographers to respect their medium and to work in a straightforward manner. He urged control by focusing and development instead of control by double printing, diffusion, and retouching, or other such means.

When he had grasped the teachings of Hurter and Driffield, he concluded that photography gave the worker so little real control that the process could hardly be considered art. He issued in 1891 a black bordered pamphlet *The Death of Naturalistic Photography.* His was a confusion of definitions, however. He continued to photograph, and the quality of his work shows no change (see article on *Emerson*).

STIEGLITZ AND THE PHOTO SECESSION

In the 1880's there was much amateur activity in England, thanks to the introduction of the dry plate and hand cameras. Most of this activity was in the pictorial field—using the term to define photographs made for artistic, as opposed to record, purposes.

In America, however, very little attention had been paid to this use of photography. Like bicycling, amateur photography was merely a craze, and little serious attention was paid to it. Yet it was in this country that pictorial photography received its greatest impetus. The motive force behind "The New American School" was the vigorous personality of Alfred Stieglitz, who has for over fifty years been the constant and untiring champion of all those workers who sincerely believe in photography as a means of personal expression (see article on *Stieglitz*).

Steiglitz began to photograph in Berlin, where he was a pupil in the Polytechnic. He received his first medal from P. H. Emerson, who was judge of a competition held in 1887 by the British periodical *Amateur Photographer*. In 1890 he returned to America and associated himself with amateur organizations. He was offered the editorship of the *American Amateur Photographer*, and the quality of this periodical he improved in a remarkable way between 1893 and 1896. As an officer of the Camera Club (New York), he served on the print committee, sponsored lantern slide competitions, and made the club's organ into the dignified quarterly *Camera Notes*. All the while he was himself photographing, in a spirit of constant experimentation. He took pictures with hand cameras under conditions so difficult that to his fellow amateurs success seemed an impossibility. His street scenes made during winter blizzards immediately became famous. He photographed by night. He made portraits by flashlight. He contributed technical papers on lantern slide making and platinum printing. By the end of the century he had received more recognition than any other worker.

In 1902, dissatisfied with existing organizations, Stieglitz and his friends formed an informal association, the Photo Secession. Quality, sincerity, and integrity were the prerequisites for membership in this group. Edward Steichen, Clarence H. White, Gertrude Käsebier, Alvin Langdon Coburn, and Frank Eugene were associates. A handsome periodical, *Camera Work*, was published, containing beautiful reproductions of fine photographs—so beautifully made that they have often been exhibited in the company of "original" prints. As Steichen explained in *Vogue* magazine (June 15, 1941), the Photo Secession fought for the recognition of photography as an art form, and for the recognition of the work of progressive artists in other mediums as well. In the gallery at 291 Fifth Avenue small shows were arranged. At first these were purely photographic, but



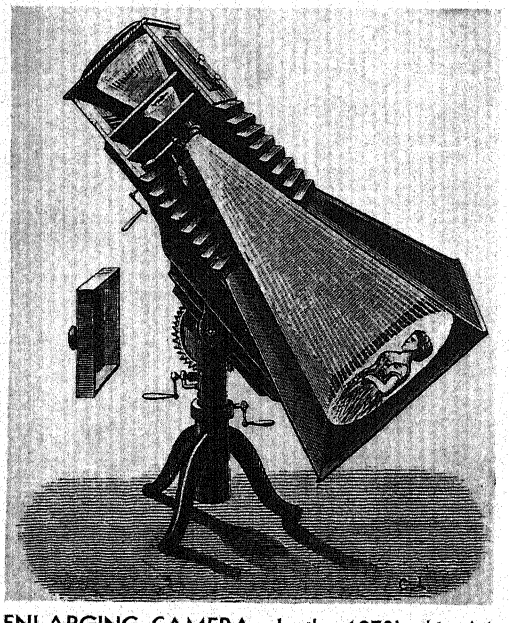
THE ORCHARD. A palladium print made in 1902 by Clarence H. White, this represents the work of the Photo Secession group. Collection of The Museum of Modern Art, New York

gradually the work of advance guard artists in other fields was shown, so that "291" became the cradle of modern art in this country. In 1910 the group held a large international exhibition of pictorial photography in the Albright Art Gallery, Buffalo. It was the most important demonstration ever organized of photography's place in the artistic world. It broke down barriers: the Albright Art Gallery bought for its permanent collection a number of the exhibits, setting a precedent subsequently, though tardily, followed by other art museums.

With World War I the Photo Secession dissolved, and the last issue of *Camera Work*, No. 50, appeared in 1917. In recognition of his work in editing this unique periodical, and for his fostering of pictorial photography, Stieglitz was awarded the highest honor of the Royal Photographic Society, its Progress Medal.

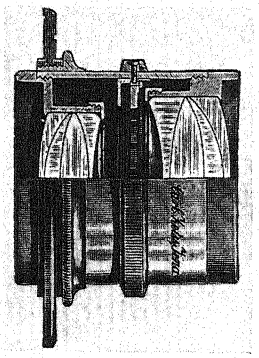
ATGET AND OTHER DOCUMENTARY WORKERS

In the meanwhile other workers were developing photography upon other lines. In France Eugéne Atget (1856?-1927) had begun a sweeping documentation of the face of Paris (see article on *Atget*). Using a cumbersome view camera, he took thousands of photographs of buildings, shop windows, fountains, statues, carriages, tradespeople. A number of these photographs—particularly details of historic buildings—he sold to libraries and museums. He worked alone, driven to tremendous activity by a deep love of Paris. On his death the majority of his negatives were saved by Berenice Abbott.



ENLARGING CAMERA. In the 1870's this A1 Solar Enlarging Camera was built—using the sun for illumination. Taken from Tissandier's *Les Merveilles de la Photographie*

Lewis W. Hine (d. 1940) took up photography in 1905 as a means of illustrating sociological reports on the child labor problem and the plight of immigrants in America (see article on *Hine*). He found that photographs carefully taken were eloquent testimony of conditions quite generally overlooked by the public. He developed a style of photography which was straightforward and clean, and which he applied to other fields—notably the documentation of Red Cross relief in the Middle European states after the 1918 Armistice, and the construction of the Empire State Building in New York City.



FIRST ANASTIGMAT. This Doppel-Protar lens was patented by Paul Rudolph and introduced in 1890 by Carl Zeiss

TECHNICAL IMPROVEMENTS

During the last part of the century, many technical improvements were made in photography. New printing processes were introduced. "Gaslight" or silver chloride developing-out paper gradually replaced the older albumen paper. Velox had been intoduced by Leo Bakeland in 1893. Platinum paper, invented by Willis in 1873, became more popular with pictorial workers, and the gum bichromate process reached a high state of perfection in Vienna, where the triumvirate of Hugo Henneberg, Heinrich Kühn, and Hans Watzek gained an international reputation. Some of Steichen's earlier work was in this difficult medium, of which he was a master (see *Gum Bichromate* article).

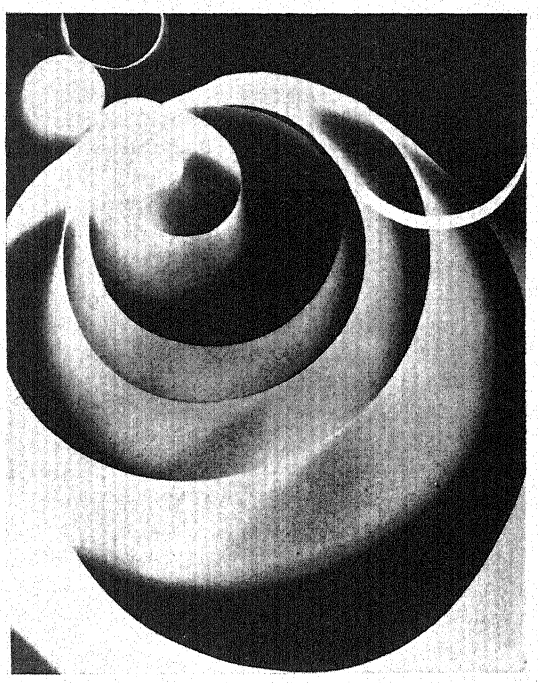
Lenses, too, were improved: Zeiss introduced the first anastigmat (Protar) in 1889, which was followed by the Tessar. Goerz introduced the double anastigmat, which was subsequently known as the Dagor (see *Lenses* article).

The color sensitivity of photographic emulsions was increased by the use of dyes, following the 1873 experiments of the German scientist and teacher H. W. Vogel (1834-1898). This innovation made practical several technics of color photography, which are discussed later.

NEW FORMS

Just before the outbreak of World War I a revolution began in the artistic world. A few artists had begun to paint pictures in which form alone was of importance and which had no recognizable subject matter. The movement grew after the close of hostilities, fanned by the Dadaist movement which consciously broke all the rules of academic art and substituted nonsense for sense in a quite serious way. On the other hand architecture was built which had no relation to the academic tradition, being planned for utility rather than for appearance. An appreciation of the beauty of machines and their products grew to the formation of the theory that beauty itself could be measured by the efficiency of function. This "functionalism" and this appreciation by the artistic world of new forms and new products was soon reflected in photography.

In 1915 Paul Strand had photographed nothing but a group of sewer pipes, with the sole purpose of emphasizing their form, and he had pointed his camera down from a bridge in such a way that the subject was not immediately recognizable, but the composition was very striking. Alvin Langdon Coburn photographed New York from skyscrapers, making the most of perspective distortion and emphasizing pattern. Independently and simultaneously in the early 1920's Man Ray, an American in Paris, and Moholy-Nagy, a Hungarian working in Germany, devised methods of making abstract photographs without the use of the camera. These Rayographs or photograms, to use words coined by their inventors, were



RAYOGRAPH, 1922. An early Man Ray shadowgraph, from *Champs Délicieux*. The technic was similar to that used by Talbot for his shadowgraphs of lace. Collection of Museum of Modern Art, New York

nothing more than shadowgraphs made by exposing sensitized paper, on which objects had been placed, to light. Moholy-Nagy capitalized upon the distortion of vertical lines caused by tipping the camera, and produced much work in which the abstract qualities are more important than the representational ones. In 1929 an exhibition "Film and Foto," in which this new approach to photography was demonstrated, was held in Stuttgart. Several books appeared with illustrations taken from this exhibition; these were widely circulated. The exhibition, together with the German moving picture *Variety* (1925), in which camera angles were used for dramatic effect, greatly influenced photographic production throughout the world.

PHOTOGRAPHY IN AMERICA

Two of the exhibitors in the "Film and Foto" show were Americans: Edward Steichen and Edward Weston. The work which they sent was quite different in character from the continental entries. The camera was placed normally, and emphasis was laid

upon its ability to render detail and subtle tonal gradations. Steichen's work of this period is quite different in character from that done while he was a member of the Photo-Secession. Shortly after the War he gave up painting and decided to make artistic use of the unaltered photographic image which he had come to appreciate while serving with the Photographic Section of the Air Corps. Edward Weston, too, had changed his style of working and adopted as a standard the 8 x 10-inch view camera with lens stopped down as far as possible; glossy contact prints from negatives developed in pyro were made. This type of photography is often referred to as "straight" or "pure," because a premium is placed on the simplest and most direct use of the medium, following the belief that by so doing, the inherent characteristics of photography can be more readily appreciated, and that the medium will yield results quite distinct from those of any other technic of picture making. These terms are unfortunate. They give a false emphasis to technic. For the beauty of such work does not lie in its mere technical perfection, but rather in the completeness of its realization of the photographer's vision.

Stieglitz's work always had this direct approach. But beautiful as his earlier prints were, the later productions must be counted his most important work. He has made of photography a personal expression, more intense and more vital than that of any other worker. The great series of penetrating portraits, the series of beautiful studies of woman—his wife, the painter Georgia O'Keeffe—the series of New York scenes, where the skyscrapers dominate man, the culminating "Equivalents"—some five hundred photographs in which cloud forms, the sky, and the sun serve as material for vivid artistic expressions—these alone would be enough. But these are part only of his output, to which must be added his constant encouragement of younger workers by painstaking personal criticism and by occasional exhibition (Ansel Adams, 1936; Eliot Porter, 1939).

Berenice Abbott, Walker Evans, Ralph Steiner, and others worked out individual styles along these lines. It is perhaps significant that the very qualities which these workers have found so beautiful had been appreciated by the makers of daguerreotypes. It was a return to tradition. The very name chosen by an informal group of West Coast workers, "f-64" was used in the 19th century by P. H. Emerson in referring to Robinson's followers. As in the development of other arts, a cycle is found repeating itself.

THE MINIATURE CAMERA

In contrast to the use of the large camera, and the desire to retain in the final print as

(*Continued on page following insert*)



COMPOSITION ANALYSIS for . . . DOURDAN—ÎLE-DE-FRANCE

Kertesz has created a subtle and tender lyric of simple people and their land. Generations cleaving to their earth, tilling, toiling, have moulded the countryside. The photographer has felt and expressed all this by seizing upon the right alignment of figures, road, trees, plowed fields, and sky to project this unity in the very picture design.

The landscape moves in a concave sweep from the high foreground down past the man and woman, on into the hollow where the road bends, and climbs again to the high horizon. Interest centers upon the standing and stooping figures of the farmers who, like everything in the picture, are magnetically pulled to the white line of the road. The composition is full of rhythmic opposed movement which runs out of the picture space. Dominant verticals of man, road, trees, and poles are cross-woven with horizontals of plowed ground textures, bushes, horizon, and sky. Strong transition is set up in the swerving road line which arches around the bending body of the woman and draws the lower section of the picture into a frame which contrasts the climbing perspective of the upper half.

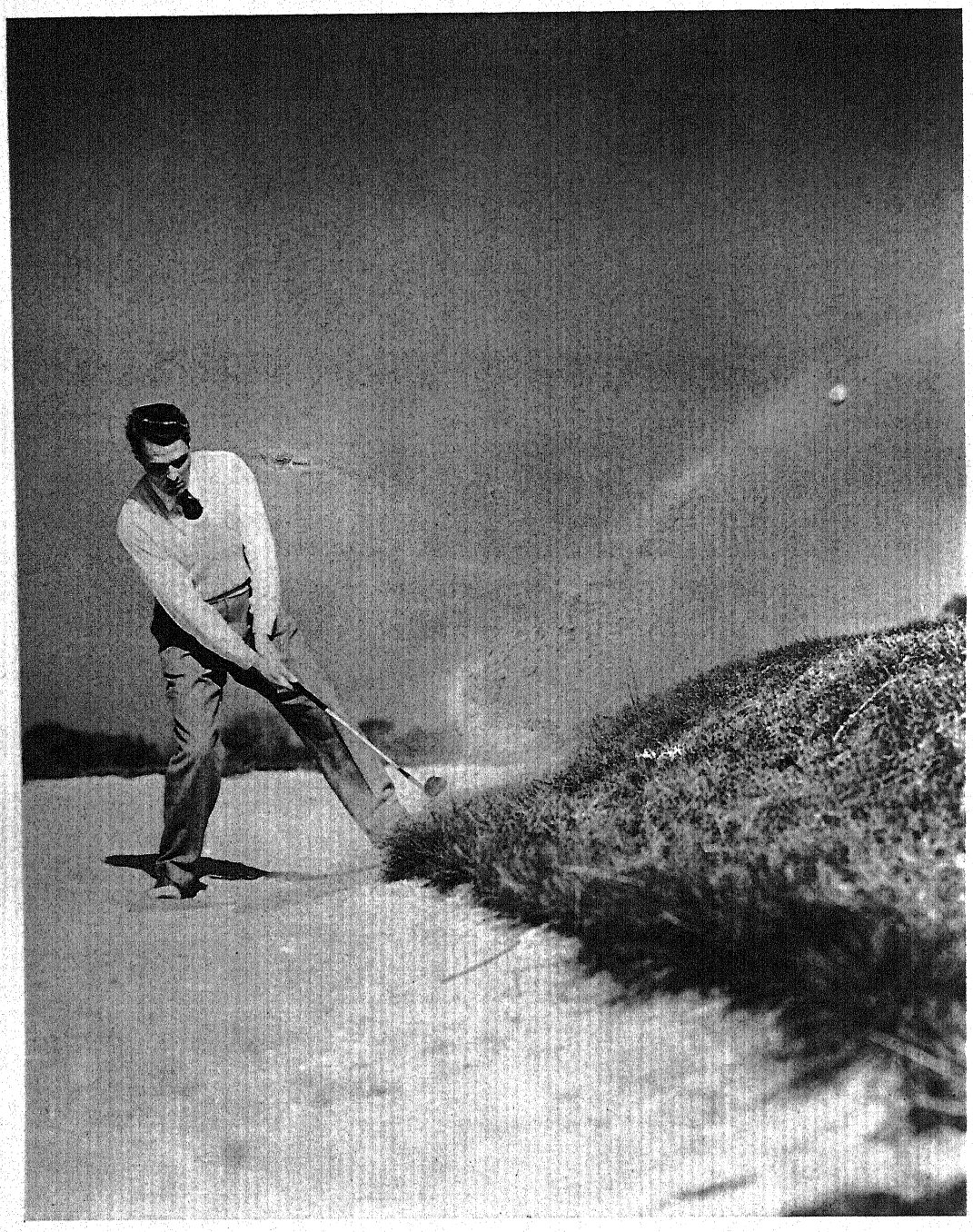
The man who stops to survey and dream, the woman who industriously grubs, are real persons but they are also symbolic of countless others. They are unposed and authentic in their gestures in the same way that the curve of the road and the forms of the trees are authentic. They all are shaped by inevitable forces. This picture is a valuable and understanding expression of a once-universal way of life which in our industrialized world will soon be rare, if not extinct.

Barbara Morgan



DOURDAN—ÎLE-DE-FRANCE

ANDRÉ KERTESZ



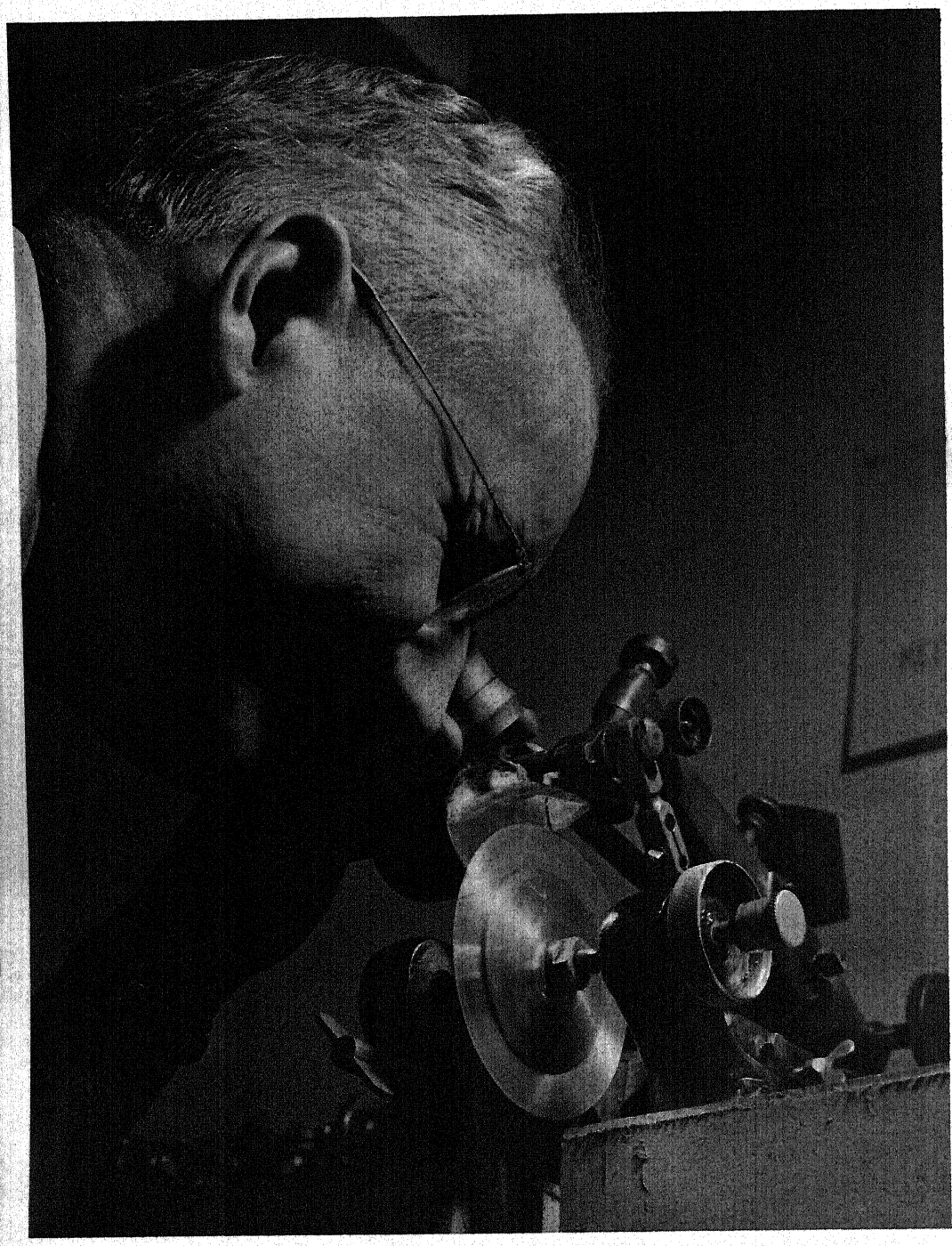
GOLFER **EWING GALLOWAY**

Here is a fast action fashion photograph in authentic setting. Notice the ball at the far right followed by a spray of sand. See article on candid fashions in *Fashion Photography*



BREAKING WAVE **EWING GALLOWAY**

The forces of an incoming wave have fascinated many photographers and now, with fast speeds, details of a breaking wave are possible. The smooth quality of the left side is nicely opposed by the agitated foam



DIAMOND CUTTER — **VINCENT LOPEZ**

This interesting portrait of a diamond cutter and his machinery was taken by a *New York Sun* photographer and hung in the Seventh Annual Exhibit of the New York Press Photographers Association. A dramatically lighted shot, every line and action emphasizes the diamond itself—the point of greater interest

(*Continued from page preceding insert*)

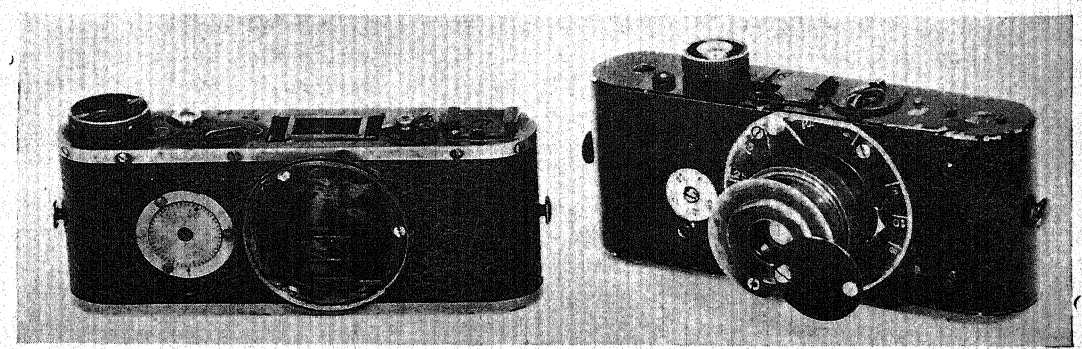
much detail as possible, is the miniature camera. This instrument has a long history. In the days of the wet plate, C. Piazzi Smyth (1819-1900) built a camera in which he used microscope glass slides for negatives one inch square. He called this instrument a "poor man's camera," and his thought in using it to photograph the great pyramids in Egypt was not so much portability as economy, for he was forced by the insensitivity of the emulsion to use the camera on a tripod. A miniature camera in the form of a pistol was patented in 1859 by Thomas Skaife, and it is said that he was arrested for pointing it at Queen Victoria. In the early days of dry plate photography many hand cameras were miniature in size. Of these perhaps the most ingenious was the binocular camera, one lens of which was used to take the picture, the other lens as a finder. A selling point of this camera was the fact that it was used at eye-level, in distinction to rival instruments which were equipped with reflex finders for use at the waist (see article on *Candid Photography*). But the use of these cameras was limited to amateurs. They were not reliable enough for the professional. Although it was possible to make enlargements (D. Von Monckhoven in 1865 writes of enlarging 2¼ x 3¼ inches up to 30 x 40 inches), it was not easy to do so, and the results did not have sufficient quality to permit a rivalry with contact prints made from larger sized negatives.

In 1914 Oscar Barnack (1879-1936), an instrument maker in the Leitz microscope works in Germany, built for his own use a still camera, accepting 35mm cinema film, as a means of making exposure tests for motion picture photography. He found it possible to make enlargements from these small negatives, and in 1924 the first Leica camera was put on the market. The camera was adopted widely by professionals as well as amateurs, and as its use became understood, the scope of photography widened enormously. Because of the small film size and consequent short focal length lens demanded, it was possible to use objectives of large aperture (f/1.5) and still retain a workable depth of field. Thus instantaneous exposures could be made in weak light. Pictures were taken in places that had hitherto been inaccessible to photo-journalists. The photographs of diplomats taken by Dr. Erich Salomon in 1929 (see page 618) are said to be responsible for the phrase "candid photography," which has since so loosely been applied to any unflattering pictures taken unawares. The miniature camera made it possible for Dr. Salomon to work inconspicuously and to record, almost instantaneously, subtle aspects of a sitter's personality.

At first limited to 35mm film, technical perfection soon made possible the use of larger film sizes with this type of approach. The Rolleiflex camera, a twin-lens reflex taking pictures 2¼ inches square, was first brought on the market in 1929. A further improvement was the adaptation of military range finders to cameras. At first these were independent instruments for measuring distance, but soon they were incorporated into the design of the camera and coupled directly with the focusing control.

PHOTO-REPORTAGE

A decided increase in the use of photographs for newspapers and magazines took



THE FIRST LEICA. This is the experimental model of the miniature camera made by Oscar Barnack in 1914

place coincidental with the development of miniature cameras. The *Midweek Pictorial*, founded by *The New York Times* to take care of the demand for photographs during World War I, had set a pattern. Existing weeklies such as the *Illustrated London News* gradually turned from drawn illustrations to photographic ones. In Germany illustrated papers became very popular and, with the establishment of the Third Reich, many of the editors of these magazines were forced to leave Germany, and worked on papers in other countries. The French magazine *Vu* was, for a short while, progressive in its use of photographs combined with text. In this close union of text and illustration they differed from such publications as the *Illustrated London News*. In 1936 *Life* was founded, a successful but conservative adaptation of continental picture magazines for American taste.

Through the demands of the editors of *Life* and of its imitators, photographers developed a technic of using flashlight to secure pictures under difficult conditions which would have the spontaneity and direct appeal of the miniature camera work of previous years, but which would also have superior quality. The electric flashbulb, a continental invention, was first put on the market in America in 1930. What had formerly been a hazardous procedure was now made harmless and convenient. Flash photography was immediately adopted by news photographers. But in their desire to make the technic as flexible and as simple as possible, they almost invariably placed the light on the camera, with the result that the photograph looked flat and uninteresting. By using several bulbs wired to the same synchronizer, it became possible to light subjects dramatically in any location with a minimum of equipment; exposure could be of brief duration and the brilliance of illumination made small apertures, with generous depth of field, possible. For the May 10, 1937 issue of *Life* Margaret Bourke-White used this technic in a picture story of "Middletown" (Muncie, Indiana). She was able to obtain free, unposed photographs by setting up her equipment and waiting patiently for all self-consciousness to pass from the subjects before making the exposure.

An important phase of reportage has been the work of the Farm Security Administration photographic project. Founded in 1935 as a means of recording existing farm conditions, this government enterprise has been well directed by Roy E. Stryker (see article on *Documentary Photography*). Among the photographers who have served with the FSA are Walker Evans, Ben Shahn, Arthur Rothstein, Russell Lee, and Dorothea Lange —two of whom, Evans and Lange, have since received Guggenheim Fellowships for independent creative work, an honor previously awarded to but one other photographer, Edward Weston. The files of the Farm Security Administration in Washington contain vivid interpretations of rural American life and its environment. Each worker has been free to practice his own style, yet despite the variety of technic and individual interpretation, the work has a unity of approach and feeling.

HIGH SPEED PHOTOGRAPHY

With the perfection of fast emulsions and with the designing of lenses of wide aperture, the minimum exposure time rapidly decreased. In 1937 panchromatic films were put on the market with a speed four times as fast as material previously obtainable, and this speed was obtained without the increase in grain size which had been commonly associated with highly sensitive emulsions.

Further radical reduction has come with the commercial manufacture of gaseous discharge speedlamps, designed by Dr. Harold Edgerton of the Massachusetts Institute of Technology (see article on *High Speed Photography*). This apparatus gives brilliant illumination for periods as short as 1/100,000 second; the camera lens is opened before the flash and closed after it, the exposure being determined by the actual length of the flash. The stroboscopic light is a modification of this principle; the flash appears intermittently, thus recording several phases of motion on one plate. The stroboscope has been used by Edgerton and Gjon Mili to produce analyses of characteristic motions in various sports with results that often have a strange adventitious beauty. The single high speed flash exposures have revealed facts about natural phenomena never before

known—that, for example, a drop does not form itself into the familiar tear shape when falling which scientists had hypothesized.

COLOR PHOTOGRAPHY

Color photography, which is bound to be greatly improved in the future, depends upon the processes of black and white photography. It has a history as old as that of photography itself (see *Color Photography—An Introduction*). Niepce wrote to his brother of Daguerre's fruitless attempts to secure the color as well as the form of nature, and many scientists sought for a way to produce color photographs directly. Only one of these attempts succeeded, and that proved to be commercially impractical. This was the interference process invented in 1891 by Gabriel Lippmann of Paris. The colors seen on the surface of oily water are produced by a modulation of light beams called interference, and Lippmann was able to apply this principle to photography. The few examples extant of Lippmann's work—the Eastman Kodak Company has two—are indeed brilliant. Since the color is actually produced by light and is not dependent upon a chemical dye, these experiments remain as brilliant today as when they were produced.

All the other practical systems of color photography are indirect—that is they depend upon the analysis of natural color into the three primary colors, and the subsequent synthesis of these primary colors into a reproduction of the natural colors.

That colors can be broken down into three primary ones was first described by James Clerk Maxwell (1831-1879) in a demonstration to the Royal Institution of Great Britain in 1861. Eight years later two French scientists, Louis Ducos du Hauron (1837-1920) and Charles Cros (1842-1888), published, independently of one another, theoretical methods of applying this principle to photography. They described, surprisingly enough, every system which has since been invented! They divided the methods into two groups, which have been termed additive and subtractive.

Additive. In the additive technic records are made of the red, the blue, and the green rays. These records are then colored to correspond with these primary hues, and are presented simultaneously to the eye, upon the retina of which the *addition* of these hues is recorded as the color scheme of the original subject. The first technic which did not involve the use of a special viewing instrument was invented by John Joly of Dublin in 1893. In front of the sensitive emulsion he placed a glass plate which bore upon its surface microscopic areas colored red, green, and blue. Positives from the negative thus obtained were bound up with the identical filter plate. In 1903 the same principle was used by the Lumière brothers for their autochromes (first marketed in 1907), except that the filters were made an organic part of the plate, and the silver image was reversed to a positive.

Subtractive. These additive processes produced transparencies, not opaque prints. These could be made by the subtractive process, in which images colored in the complementary hues of the primaries were superimposed. Ducos du Hauron had shown how this could be done, and suggested the use of the carbon process—first introduced in 1855 by Alphonse Louis Poitevin (1819-1882) as a permanent printing technic. In 1872 Blanquart-Evrard published, in the pamphlet *Les Couleurs en Photographie*, a print made from negatives of Ducos du Hauron. Although the exact technic is not known, this is the earliest three-color photographic book illustration known.

The subtractive process was rapidly assimilated by photoengravers. Important research in the field was done in this country by Frederic Eugene Ives (1856-1937) who, in 1885, exhibited proofs. The common photographic color printing processes of today—carbo, wash-off relief, and toning—are all descended from the theories of Ducos du Hauron and Cros. One drawback to these methods is the need of making three separate exposures, one for each of the three negatives. In the case of stationary subjects, the three exposures can be made in succession with any camera. But moving objects require a one-shot camera which will expose these plates simultaneously. Many ingenious cameras have been devised, employing mirrors, pellicles, and other beam-splitting devices, but they are all complicated.

The introduction of Kodachrome in 1935 obviated this drawback. One film contains three emulsions, each sensitive to but one of the primary colors, and each emulsion is developed, reversed to a positive, and dyed in the appropriate complementary color. The result is a transparency, but one without grain and of such quality that three color separation negatives can readily be made from it in the laboratory for the production of color prints. Minicolor and Kotavachrome prints were announced by Eastman in 1941 and, with this subtractive printing process based on the monopack, the color print was brought within the range of the amateur's purchase. And, in 1942, Eastman brought out Kodacolor film—a subtractive color negative process.

An esthetic rationale of color photography has yet to be worked out. But as more and more workers are attracted to the various processes, definite progress is being made in the recognition of photographic color as an independent medium.

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PUBLIC COLLECTIONS IN AMERICA

American Museum of Photography, Philadelphia, Pa.

Franklin Institute, Philadelphia, Pa.

Metropolitan Museum of Art, New York.

Museum of Modern Art, New York.

Brooklyn Museum, Brooklyn, N. Y.

Boston Museum of Fine Arts, Boston, Mass.

Cleveland Museum of Art, Cleveland, O.

Albright Art Gallery, Buffalo, N. Y.

HISTORY OF PHOTOGRAPHY—MOTION PICTURES

Beaumont Newhall

Curator of Department of Photography and Librarian, Museum of Modern Art; Author of Photography: A Short Critical History

This history of cinematography is, of course, bound up with the history of photography in general and by all means the *History of Photography* article (page 1995) should first be read for background material. Discussed here is the development of the moving picture technic from the animated drawings of 1832 to the inception of sound movies. The work of Muybridge, Marey, and Edison are discussed —as well as early movies like *The Great Train Robbery* and *The Birth of a Nation.*

See Also Growth of Photography (page 4), Analyzing Motion Pictures, Cinematography—Professional, History of Photography

THE LIFE BLOOD of the moving pictures is photography. The story, the action, even the dialog and musical score of a film are all brought to the screen by photography. Yet while the history of moving pictures has been written many times, the vital part played by the cameraman has received comparatively little attention. It is the purpose of this article to trace the development of cinematography from its origins to its emergence as one of the most powerful art forms of our modern time. In many ways the article forms a logical supplement to the previous article, *History of Photography*; certainly it cannot be fully understood without a knowledge of that background. Cinematography, however, differs from still photography in three important ways:

1. *Continuity.* The still photographer stops time in its tracks; the cinematographer recreates time according to his will. He develops a continuity of action. Each of his shots is but a unit; none is complete in itself.
2. *Presentation.* The cinematographer's work is presented in a fairly uniform manner—by projection in a dimly lighted hall, on a screen distant from the audience. The positive is a transparency, with a potential tonal scale far greater than that offered by any paper print.
3. *Composition.* While the still worker can ruthlessly crop his print, or enlarge but a small portion of the negative, the

movie cameraman must compose within the full negative area. Any change of image size must be done when the negative is exposed. Hence the professional cinematographer prefers a battery of lenses, usually mounted on a turret for ready and rapid changing.

These characteristics were early recognized by cinematographers. It is significant that by far the majority of successful cameramen have had little or no still camera experience. The early workers were mostly jacks-of-all-trade around the studio. G. W. Bitzer, D. W. Griffith's cameraman, was an electrician, for example. The apprentice system is still the standard form of education.

ORIGINS

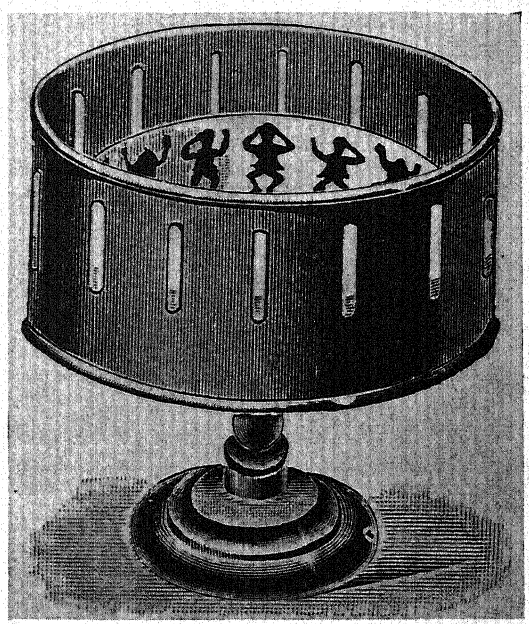
The origins of cinematography must be sought years before the crudest practical results. To an even greater degree than in still photography, similar—even identical—ideas were worked out independently by various inventors; the problem of disentangling these respective contributions becomes a difficult task, which hardly any two historians have solved in agreement.

Moving pictures move because of a defect in human vision. There is a limit to the number of successive impressions which the eye can distinguish. A hand, waving at a rate faster than ten strokes per second, appears blurred because our eyes cannot keep up with the action. Before the image of the upraised hand has disappeared from our retina, the image of the hand at the downbeat has been received and a "double exposure" is registered by the sensitive retina. In other words, it takes an appreciable time *to get rid of an image*, and this phenomenon is known as persistence of vision.

Animated Drawings. Exact drawings could be made of a number of positions of the waving hand between the highest and the lowest points in its motion. If these drawings were presented to the eye, one at a time and in the order of their position, at a rate of ten or more per second, an illusion of motion would be produced. Before drawing 1 had left our retina, drawing 2 would have been registered. The two, closely similar, would merge. As drawing 2 disappeared, drawing 3 would be seen. The drawn hand would seemingly have moved lower (or higher) smoothly, gradually, and in a lifelike way.

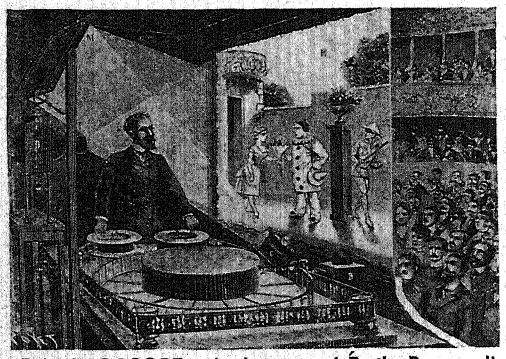
Apparatus for presenting such animated drawings to the eye were worked out in the early nineteenth century as means of proving the theory of the persistence of vision and as amusing toys. In 1832 Joseph Antoine Ferdinand Plateau in Ghent and Simon Ritter von Stampfer in Vienna independently devised viewing machines. Plateau's "Phenakistoscope" consisted of a disc fixed to a handle. On one side were drawn various phases of a short cycle of action which normally repeated itself in nature (as a boy jumping rope). Between each drawing was a slot. The disc was twirled and held with the drawings close to a mirror. Peering through the slots, the spectator saw the figures moving through the action over and over. The explanation is simple: as each slot moved past the field of vision, a momentary glimpse was afforded of one of the figures as reflected in the mirror. The speed with which the slots followed one another was so great that a fresh figure was seen before the image of the previous one had left the retina.

Similar in character was the "Zoetrope" of W. G. Hornor (1834). Here slots were



ZOETROPE. An early and simple device for viewing animated drawings. From The Museum of Modern Art Film Library

cut in the periphery of a hollow drum, inside which a band of drawings was placed. In 1877 the principle was modified still further by the Frenchman Émile Reynaud. His "Praxinoscope" consisted of a drum inside which the drawings were placed. But the spectator, instead of viewing one drawing after another through slots, looked at the hub of the drum, which was a polygon faced with mirrors. As each mirror came into view, a fresh drawing was reflected in its surface.



PRAXINOSCOPE. A drawing of Émile Reynaud's Théâtre Optique, where animated drawings were projected for a large audience. From The Museum of Modern Art Film Library

An even simpler method of presenting the images to the eye was simply by making a fat book, with a drawing on each page, which was flipped past the fingers. In 1868 this device was patented at the "kineograph"—a name which later became more famous in a modified form (see article on *Animations*).

Projecting the Drawings. These animated drawings could be seen by only a few people at once. Various attempts were made to project the images on a wall by using the principle of the magic lantern, which had a history as old as that of the camera obscura. One of the most successful was Reynaud's "Praxinoscope Optical Theatre," where the mirror reflections were projected by a lantern onto a translucent screen, which was viewed on the opposite side by an audience. To give a reasonable length, Reynaud drew his images on a long band which, by means of perforations, traveled about the interior of the drum of his machine. This apparatus he operated on the boulevards of Paris. "Autour d'une Cabine," a humorous sketch, was presented 100,000 times at the Musée Grévin from 1894 to 1900.

ANIMATED PHOTOGRAPHY

The drawings for these various early moving picture machines were difficult to make. Accuracy was essential, and it is hardly surprising that the idea of substituting photographs for them should have been thought of early in the history of that medium. The difficulty was the stopping of action with the relatively insensitive wet collodion plates in use up to the 1880's. Heyl in Philadelphia took a series of *posed* photographs of successive phases of motion, and these he projected in 1870. This experiment graphically demonstrates the basic unreality of moving pictures. From a series of static time exposures an illusion of swift motion was given to the audience.

In 1872 Eadweard Muybridge began photographing animals in motion; by 1878 he had published results in scientific periodicals. His method was unique and simple: a battery of still cameras faced a racetrack, horses were ridden past the cameras, and, by an ingenious synchronization device, each camera was exposed just as the horse was opposite its lens. The results were poor technically, for the wet plates were badly underexposed at the speeds which Muybridge was obliged to use, and nothing was seen on the negative beyond a thin vague image. It was enough, however, to enable an accurate silhouette of the animal's body to be traced, for the purpose of studying the position of his legs (see article on *Muybridge* and illustration on page 2011).

The French scientist Étienne Jules Marey saw Muybridge's results when they were published in the magazine *La Nature*. He at once communicated with the American, for he himself had for years studied the attitude of animals in motion. Using mechanical apparatus, he had formed definite theories of locomotion. From data thus recorded, drawings had been made which, in 1867, he attempted to animate in a zoetrope. Muybridge and Marey met in Paris in 1881, and some of Muybridge's photographs were actually projected. There is evidence that Muybridge had animated his photographs even earlier.

The union of action photography and animation was accomplished: cinematography had come into being.

THE SINGLE CAMERA OF MAREY

There were drawbacks to Muybridge's method which Marey was quick to see. Because each photographic image (or, to use modern terminology, each *frame*) was taken from a fresh viewpoint, the background appeared to move, and this was particularly noticeable because the horse was centered in each frame. The beast appeared to be kicking the ground past his feet. Today we have accepted the traveling camera, which gives this unusual effect similar to the sense of backward motion felt when looking out of the window of a slowly moving train at another moving in the same direction at faster speed. But this is only one of the effects of the movies which, once labelled false, we have learned to accept.

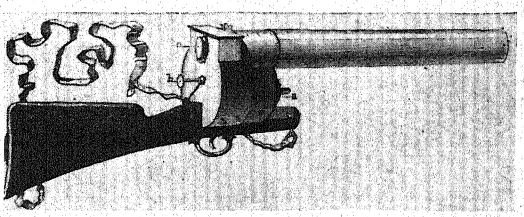
Marey therefore sought to make a series of action photographs from one point of view, through one lens. He accomplished this in 1882, using a camera which he aptly described as a photographic rifle. A regular gun stock was fitted with a tube in place of a barrel, containing a long focal length lens. A revolving plate was let into the breech. Twelve frames per second, at 1/720 second each, were taken on an octagonal plate coated with gelatino-bromide emulsion.

There was yet one more drawback to these technics, and this Marey removed. The number of consecutive frames which could be taken of a moving object (in other words the length of each "take") was limited by the number of cameras, or by the size of the revolving plate. In 1888 Marey used an endless band of sensitized paper, which was moved intermittently past the focal plane in synchronization with the shutter. A year later he replaced the paper strip with film. The frame size was 9 x 9 cm. (about 3½ in.). Photographs so obtained were exhibited in a zoetrope at the Paris Exposition of 1889, and there Marey personally demonstrated his apparatus to Thomas Edison.

EDISON AND THE KINETOSCOPE

The American inventor, in a letter dated January 24, 1925 and published in the *Transactions of the Society of Motion Picture Engineers* for that year, quoted from his early notes: "In the year 1887 the idea occurred to me that it was possible to devise an instrument which should do for the eye what the phonograph does for the ear, and that by a combination of the two all motion and sound could be recorded and reproduced simultaneously. This idea, the germ of which came from a little toy called the zoetrope and the work of Muybridge, Marey, and others, has now been accomplished so that every change of facial expression can be recorded and reproduced life size."

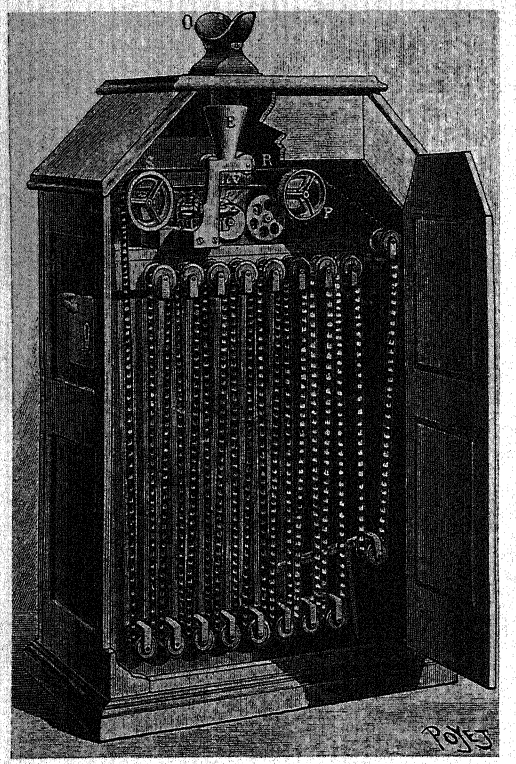
The kinetograph (camera) and the kinetoscope (viewer) were patented by Edison in 1891. After fruitless attempts to record minute images on a cylinder similar to the "record" of the first phonograph, Edison turned to film which George Eastman supplied to him in 1889. As finally specified, this film was approximately 35mm in width and was punched with four sprocket holes on each side of the frame, which measured 1 x ¾ inches. This standard was subsequently adopted internationally. Forty-six frames per second were exposed. The print was viewed in a "peep hole" cabinet, in which the film, an endless band, passed over a series of rollers. The device was electrically driven and the print was lighted by one of Edison's own incandescent lamps. Thousands of these kinetoscopes were put on the market; they showed short films (about 50 feet in length) of prize fighters, vaudeville turns, or novelties such, for example, as *The Execution of Mary Queen of Scots* (1893) where, in the space of a few seconds, the actress kneels, the headsman swings his axe, and the head rolls on the ground.



PHOTOGRAPHIC RIFLE. Invented by Marey in 1882, this was for "chronophotography on moving plates." From The Museum of Modern Art Film Library



THE KINETOSCOPE—THEN AND NOW. At the left is a Kinetoscope Arcade in San Francisco, shown when the moving picture was comparatively new. At the right is a modern arcade at an outdoor carnival—showing little change in the mechanism or the type of performance. Photos from The Museum of Modern Art Film Library (left) and the Farm Security Administration (right)



KINETOSCOPE DETAIL. The peep show viewing machine, perfected by Edison in 1891. The series of images passed over *R* and *S*, beneath the viewing cone *(E)* and above the electric illumination *(L)*. From The Museum of Modern Art Film Library

PROJECTORS

The need for some way of projecting these films on a screen, where they could be viewed by many people at once, was soon felt. The mere listing of the workers who independently and simultaneously devised projection machines is vivid proof that the time was ripe for the perfection of moving pictures. The following inventors held public demonstrations:

Woodville Latham—New York, 1895
C. Francis Jenkins—Richmond, Va., 1895
Thomas Armat—Washington, D. C., 1895
Louis and Auguste Lumière — Lyon, France, 1895
Robert W. Paul—London, 1896
Max and Emil Skladanowsky—Berlin, 1896
Oskar Messter—Hamburg, 1896

Of these many projectors, two are of special importance: those of Lumière and Armat.

Lumière Projector. The original Lumière projector was nothing more than the camera used for taking the films, the cinematograph. The back was removed and it was set on a bench in front of an arc light and a condenser. The film was cranked through the aperture gate and was gathered in a basket placed on the floor. The combination

camera and projector was directly inspired by Edison's kinetograph and kinetoscope; it accepted film of the same width, but used only two perforations per frame. The normal rate of speed at which pictures were taken and projected, sixteen frames per second, was less than Edison had specified. The standard was subsequently adopted internationally, and remained in universal use up to the advent of sound, when the rate was increased to twenty-four frames per second.

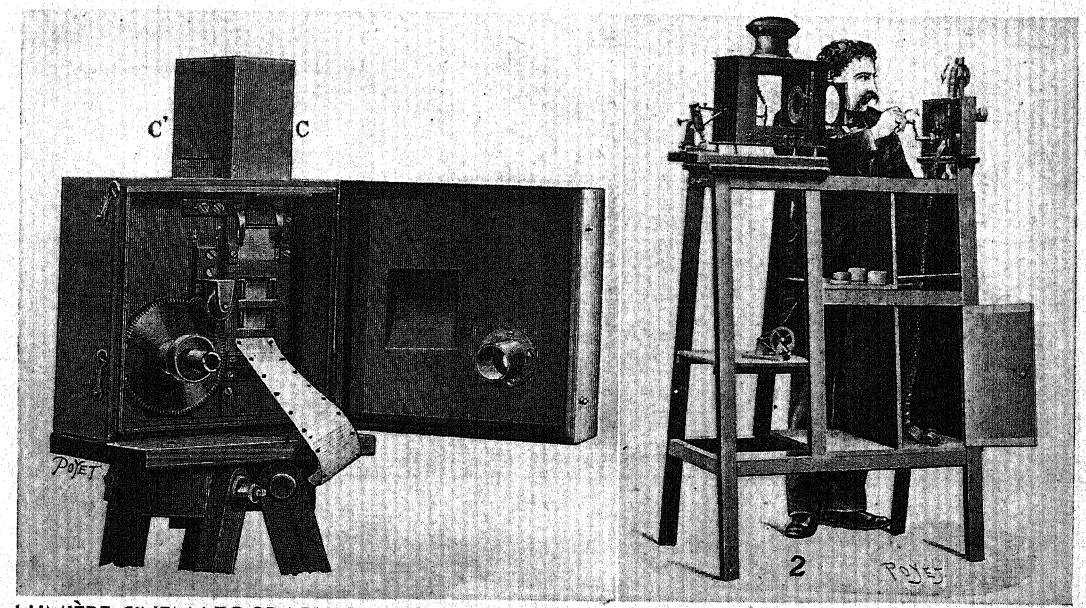
The fifty foot film of a kinetoscope, passing through the machine at 46 f.p.s., lasted only 18 seconds; the same length of film in the cinematograph would last 50 seconds. Obviously the Lumière system was more economical. Furthermore the French camera was a light portable affair. It could be carried about easily. Films were made of every-day events (*Workers Leaving the Lumière Factory; A Train Entering a Station*) or of humorous incidents (*Watering the Garden—er*) which took place in natural surroundings. Edison's camera was cumbersome, heavy with the rudimentary electric drive. This led to a tendency to keep the camera in the studio and bring actors before it. In the tar paper shack at Orange, N. J., dubbed the Black Maria, simple vaudeville turns were enacted. These films were all shown in the original peep show kinetoscope.

Vitascope. Faced with the competition of projected films like those of Lumière, Edison's laboratory was devising a machine when Edison saw the Vitascope projector of Armat—a projector which, from the evidence



LUMIÈRE COMEDY. Here is a frame from the outdoor moving picture story by Lumière called *Watering The Garden—er*. Notice the large perforations. From The Museum of Modern Art Film Library

presented in a lengthy law suit, seems to have been based on Jenkin's Phantascope. In 1896 a public performance of Edison films was given at Koster and Bial's Music Hall, New York, on this Vitascope projector. The movies were introduced to America as public entertainment. Competitors at once



LUMIÈRE CINEMATOGRAPH CAMERA AND PROJECTOR. Both perfected in 1895, the camera (left) is shown with the take-up magazine removed. The projector (right) consisted of the camera mounted in front of an arc light and condenser. From The Museum of Modern Art Film Library

followed this example but Edison's patents were rigid and watertight.

Bioscope and Mutograph. A rival projector, the Bioscope, was used in a New York theater only a few months later. This machine developed from the Mutoscope, a peep show machine in which a series of paper prints mounted on a drum were flicked past a peep hole in which was fitted a magnifying glass—a simple adaptation of the 1868 Kineograph. These paper prints were enlarged from a negative 2½ inches wide made in the Mutograph camera (1895), the invention of Herman Casler. The machine was ingeniously designed to be dissimilar to Edison's camera in every particular. The film was wider, it was placed in the camera unperforated, and at the moment of exposure two holes were punched in it. The frames were not placed on the film in regular order, but haphazardly.

With this cumbersome camera was made the film shown with great effect to the Broadway audience of 1896—*The Empire State Express*. The crack train came into view, approached the camera, and roared past it seemingly right into the audience.

THE GREAT TRAIN ROBBERY

Railroads have ever been grateful subjects for the cinematographer. The Lumières had shown a train arriving at a station, and in 1903 Edwin S. Porter made for the Edison Company *The Great Train Robbery*, one of the earliest narrative films. It is a simple adventure: a gang of robbers overpower a station master, board a train as it stops for water, decamp with their loot, and finally are caught after a horseback chase. What is of interest is the use of the camera and the piecing together of the "shots." So miraculous did the photographic reproduction of action seem in the early years that nothing more was required of a cameraman than an ability to shoot accurately from one point of view.

THE BIOSCOPE CAMERA

MODEL "A" (Patented) for Scientific and other Purposes.

Is constructed to take from 50 to 1,500 feet of Sensitised Film, which makes it possible to take a **Continuous Cinematograph Picture of events lasting THIRTY CONSECUTIVE MINUTES WITHOUT RE-LOADING.** This fact is of special interest to **Travellers, Explorers, and Scientists,** to whom it is of the highest importance to have a complete record of scenes, events, and phenomena which they desire to preserve for future instruction or amusement.

An effective Instrument, simple in its manipulation, certain in its results, and perfection in its workmanship and finish.



THE CAMERA OUTFIT

CONSISTS OF

Two Daylight Loading Film Boxes (capacity 600 feet each), each fitted with brass Film Reel and re-winding device (interchangeable).

One Voigtlander or Dallmeyer Objective, either 2½, 3, 3½ or 4 inch focus, full aperture, F 5·4. These Lenses are mounted in cylindrical tubes (velvet lined) of special design, so that events or incidents can be photographed **against the sun** without being effected by the glare or reflection. The Iris diaphram is adjusted from the front of these tube mounts by means of an ingenious arrangement. **No guesswork** in setting the Iris. The objectives so fitted can be instantly removed and replaced by different focus lenses by simply sliding same in or out of the Lens-mount as occasion requires.

One Special Brass Mount with Rack and Pinion Adjustment.

Raising and Lowering Front with Rack, Pinion, and Clamp Adjustment.

An Adjustable Focal Plane Shutter, admitting of Exposures varying from $\frac{1}{25}$ to $\frac{1}{1000}$ part of a second.

Automatic Register for enumerating the number of feet of Film used after each series of exposures.

Automatic Film Punch for marking the Film between the incidents photographed, thus preventing the cutting of the Film in the wrong place when preparing same for developing in the Dark Room.

Lens fitted to Focussing Sight Hole to magnify image on Film.

Automatic Film Re-winding Device. Rigid Camera Tripod.

Special Travelling and Carrying Case for Camera and Accessories (iron bound and fitted with lock, key and handles).

The Mechanism is of a combined continuous and intermittent principle, allowing the film to be "fed" between two loops, preventing thereby any strain or "plucking" on the Film or injuring the perforations thereof, at the same time assuring **absolute correct registration.**

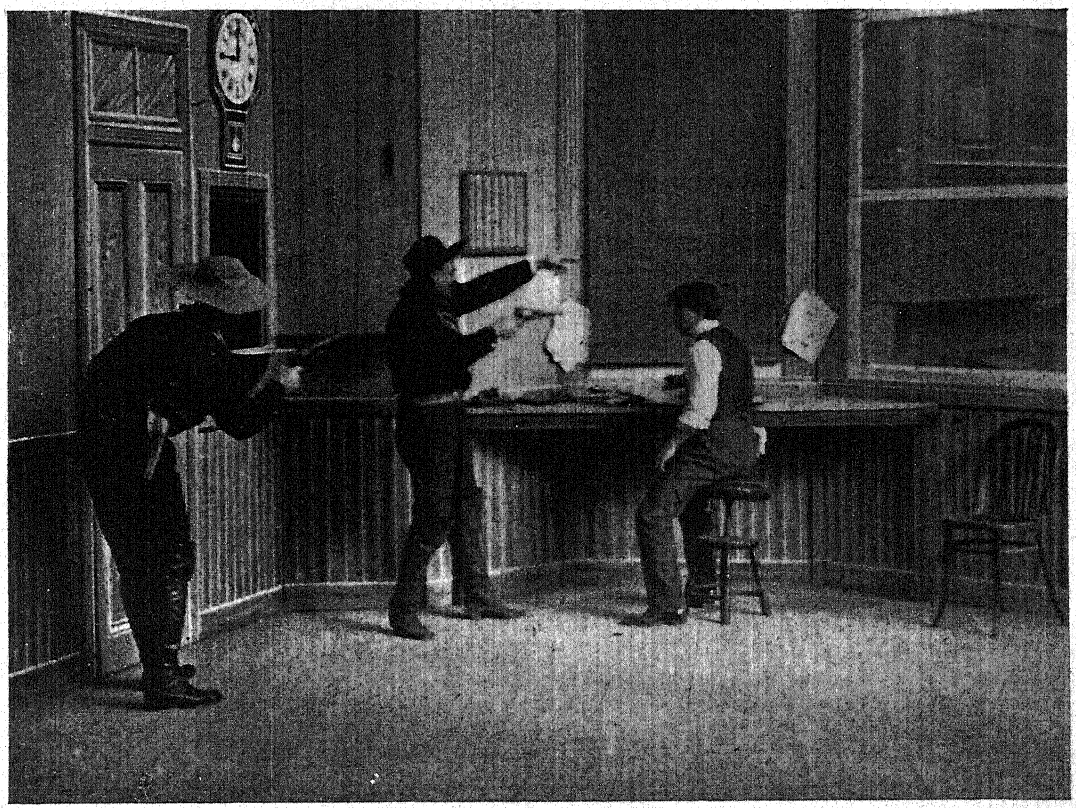
The best quality of Steel, Gun-metal and Brass is employed in the manufacture of these Instruments. All metal parts are oxydised, and are of the best workmanship. The Cases and Film Boxes are made of thoroughly seasoned mahogany, and are guaranteed Light-proof. Will stand all climatic changes. Finished in highly polished ebony.

No one can afford to take an event or incident (which may only present itself once in a lifetime) and have it turn out a failure owing to the inefficiency of a cheaply built apparatus which may have been employed. The Best is the Cheapest always.

NOTE.—All "Warwick" Film Subjects are taken with the Bioscope Camera. You can thereby judge of the accuracy and steadiness of the Apparatus.

		£	s	d
PRICE OF OUTFIT (complete as above, Code Word "BIOCAMERA"		£45	0	0
,, **EXTRA FILM BOXES** complete (capacity 500 feet) each		2	0	0
,, **RIGID CAMERA TRIPODS** 4½ feet high		2	5	0
,, ,, ,, 5½ feet high		2	10	0
,, **RIGID CAMERA TRIPODS** with revolving top		9	0	0
,, **TRAVELLING CASE** for Camera and Accessories		1	5	0
,, **CARRYING CASE** (capacity Three Film boxes		0	15	0
,, **BIOSCOPE CAMERA LENSES, fitted in special mount** (as supplied with the **Bioscope Camera,** either above-mentioned Focus - - - - - - - - - - - each		5	0	0

BIOSCOPE CAMERA. A contemporary advertisement tells about all the special features of an early motion picture camera



THE GREAT TRAIN ROBBERY. A still from the 1903 motion picture directed and photographed by Edwin S. Porter for the Edison Company. Several new technics were used in this picture, including the masking technic. Here the indoor scene and a second one of the moving train were combined. From The Museum of Modern Art Film Library

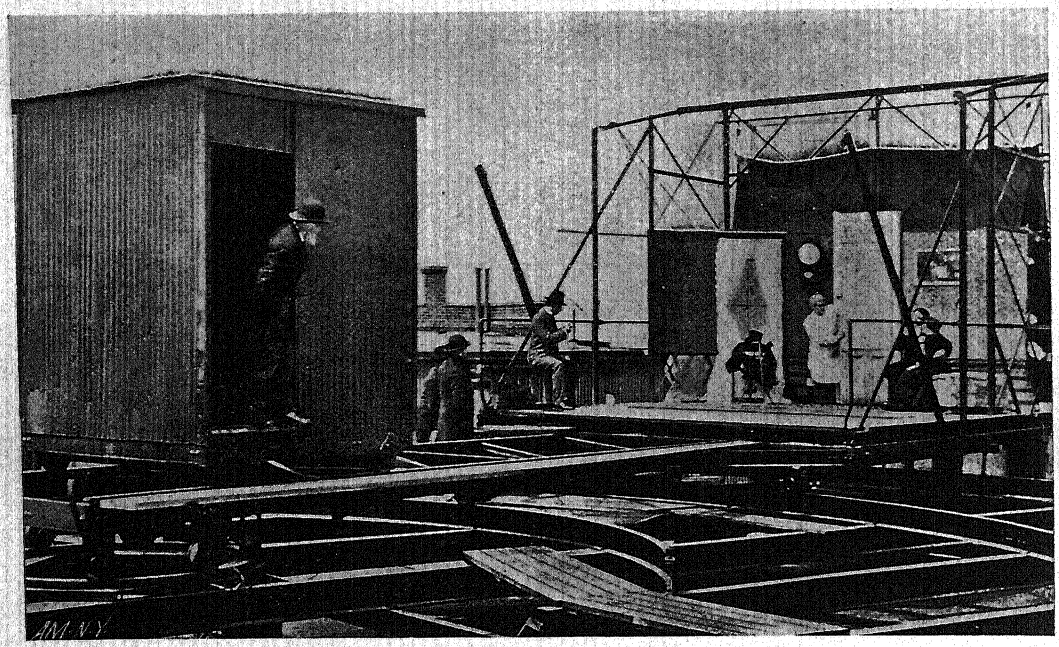
The effect of looking at the earliest films was of viewing a scene from one stationary place. But in *The Great Train Robbery* a number of scenes are represented, and the order in which they are thrown on the screen heightens the dramatic tension. The problem of organizing shots is called "cutting," or "editing"; while it is not a purely photographic process, it is of such importance in the development of moving pictures that it cannot be dismissed in even a short outline of the history of cinematography.

In the Porter film is to be found one of the earliest uses of the close-up. A detail—the masked face of the robber chief—fills the whole screen. This was a startling innovation. It was as if suddenly the spectator of a play was magically whisked from his seat in the auditorium onto the very center of the stage, two feet from the leading actor! Here was a comparatively new and amazing device.

CINE TRICKS

Another feature of *The Great Train Robbery* was its ingenious use of the technic which has come to be known as the "mask shot." In the scene within the railroad station, when the robbers overpower the stationmaster, the moving train appears through the window. The interior was, of course, a studio set. The action taking place within it was photographed through a mask which exactly covered the window area. The film was then rewound in the camera and the train was photographed through another mask which covered up all the area of the frame except that occupied by the window in the original shot. In another scene a fight takes place in a moving baggage car and through the doorway the landscape is seen tearing by. This also was done with two masked exposures.

Photographic tricks similar to the mask shot became very popular. They were used



MOVABLE STAGE. By a complicated set of tracks, the stage could be kept facing the sun and the camera (in the house at the left) could be moved up for a semi-close-up. For photographing scenes with the Mutograph camera, 1895. From the *Scientific American*. Courtesy Museum of Modern Art Film Library

not only as a means of heightening the feeling of realism, but also for exactly the opposite purpose—for their unreal, fantastic, and humorous value. Typical of this type of camera gag is the "stop frame"—a trick which requires no special equipment and which any amateur can duplicate. At a given moment of action the camera is stopped, and the actor "freezes" into immobility. A change of some sort is made in the scene, the camera is started, and the actor carries on. For example, the director wants to have a man's hair miraculously disappear, leaving him bald as a billiard ball. Footage is taken of the actor with a wig of luxuriant hair. The camera is stopped, the wig is replaced by a hairless one, and the camera is started again. On the screen, of course, the effect is the sudden loss of a full head of hair. Mask shots were used to permit an actor to argue with himself. Double exposures for "spirit pictures," ghosts, or for the revelation of a character's passing thoughts were common. All these tricks required a camera which allowed the film to be wound backwards. Simply by running the film backwards the most ludicrous results could be obtained: the diver springs upwards from the water which closes in after him; the running man rushes hindside foremost without looking where he is going; pieces of chinaware form themselves into an expensive jardinière, to the infinite relief of the careless housemaid.

D. W. GRIFFITH

But the Biograph camera could not be run backwards. The company could not compete in the popular field. By 1908 they were desperately seeking some novelty with which to outstrip their competitors. They found it in the person of D. W. Griffith, an actor and writer who applied for work at the studio. Griffith was fortunate in finding a sympathetic technician, G. W. (Billy) Bitzer, who became his cameraman. The two worked together—Griffith making demands which Bitzer, with great ingenuity, met in unusual ways. New effects, since a common part of the grammar of the film, were hit upon accidentally by Bitzer and seized up by Griffith.

Both vignettes and fade-outs are examples. Bitzer, experimenting with artificial light in his basement, found that he needed a lens hood to prevent lens flare. So he im-



BIRTH OF A NATION. A close-up scene showing Henry B. Walthall and Lillian Gish from D. W. Griffith's famous motion picture, filmed in 1915 for Epoch Producing Corp. From The Museum of Modern Art Film Library

provised one from an old glue pot. It worked perfectly with the stop wide open, but when he used it out-of-doors, the depth of field at the smaller stops demanded by the more brilliant illumination increased to such a degree that the front of the hood was brought partially into focus. It was a mistake, as the corners of each frame were cut off. But Griffith, seeing them, was delighted and instead of criticizing Bitzer he praised him. For the vignette effect gave him a dramatic device, focusing the attention of the audience on the center of the screen. So Bitzer made an adjustable vignette from the diaphragm of an old still camera lens. To manipulate it easily he fastened a handle to the short control lever. Once, when shooting, the weight of the handle caused the diaphragm to close slowly. The result was a gradual dimming of the screen, until the projected image was blacked out—a fade-out.

The Birth of a Nation (1915) is the most important film made by the Griffith-Bitzer team. It was a deliberate attempt to recreate with historical accuracy episodes of the Civil War. It was filmed entirely in natural light, on orthochromatic film, with one camera—a light Pathé machine which could easily be carried from set-up to set-up. An analysis of the film shot by shot shows Griffith's mastery of the medium. The generalties of long shots were explained in detailed close-ups; the camera became much more than a means of recording motion, it became an instrument which directs our vision to the significant aspects of the story, from broad views of entire battlefields to close study of the expressions and movements of individual actors.

Following this success Griffith and Bitzer filmed *Intolerance*, a complicated four-part scenario in which the history of tolerance



BIRTH OF A NATION. A long shot from D. W. Griffith's motion picture, showing Sherman's march to the sea. From The Museum of Modern Art Film Library

in four different ages is told simultaneously in realistic fashion. Here a traveling camera is used with a frequency never before seen. In a vast reconstruction of Nebuchadnezzar's Palace steps the camera was placed some fifty feet high and moved slowly forward. It was also fastened to the front of a speeding automobile to give tense close-ups of actors driving while the landscape tears by.

CONCLUSION

By the close of World War I it may be said that the medium of the motion picture had been established. All that followed was built upon this foundation. Cinematographers have become more skilled; the advent of sound has eliminated titles, obvious pantomime, and much of the need to focus attention upon detail. The camera has become completely mobile, and follows with ease the most complicated action (see article on *Cinematography—Professional*). Motion picture film stock has been improved, so that the image is finer in quality and in definition; the panchromatic emulsion has become universal. New lenses have been introduced, and many of the innovations discussed in the preceding article have been taken over by cinematographers—abstractions and color, for instance. The history of cinematography has been one of expansion rather than of change of direction. The present-day worker is able to take movies under conditions which only a few years ago were impossible, but he uses the same basic principles and apparatus.



MOVING CAMERA TECHNIC. Filming one of the final scenes of *Intolerance*, D. W. Griffith is shown crouched behind the Pathé camera and G. W. (Billy) Bitzer is standing. The moving camera was one of the many interesting and novel technics of film making introduced or adopted by Griffith and the technic was used in many other scenes—including one showing Nebuchadnezzar's Palace, in an earlier part of this four-part motion picture. From The Museum of Modern Art Film Library

MUSEUM OF MODERN ART FILM LIBRARY

The Museum of Modern Art Film Library was founded in 1935 on a grant from the Rockefeller Foundation to make possible a considered study of the film. With the cooperation of the film industry, the Library has collected many significant and influential films of the past forty years and is now distributing them throughout the country to museums, colleges, and study groups. Ten series of programs are now available to subscribers.

The motion picture as art, entertainment, and social document has hitherto been little studied except in written criticism: it has not been possible to screen the films of the past. Today the world has recognized the film's persuasive power in the unconscious education of children, in molding public opinion and manners, in creating esthetic experience for the millions. But while the

motion picture as a medium grew strong and ubiquitous, individual films, by nature ephemeral, were lost. Students who wished to analyze the sources of the cinema's power, to trace its swift growth, found that many of the most famous and historically important pictures had disappeared. Even when their location was known, it was difficult to see them again.

As the Film Library continues its work of collecting and preserving significant and influential films, and making them available for re-examination and study, a new phase is already being initiated. A comprehensive understanding of the film is increasingly regarded as essential to a well-grounded education, not only because it exercises a profound influence in forming the taste and affecting the attitude of life of the millions who weekly attend film showings, but because it is the liveliest and the youngest of the arts.

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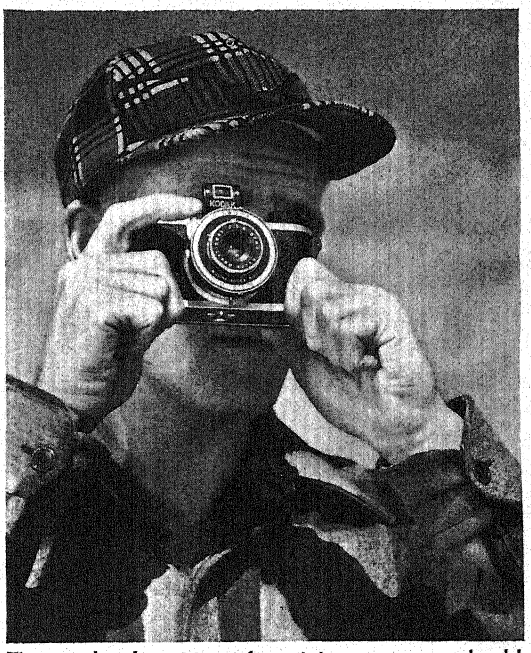
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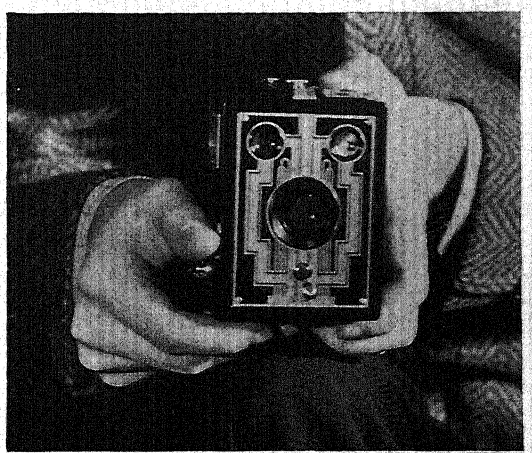
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HOLDING THE CAMERA. One of the most constant sources of trouble for the photographer is an unsteady camera. Where accurate aim is all-important, the hunter spends hours learning how to hold his gun and pull the trigger for smooth action. For the photographer, a steady camera is just as important—for the finest lens in the world cannot render a sharp image if there is the slightest "camera shake." This is particularly true of the miniature camera, where the image is enlarged and imperfections exaggerated, and the motion picture camera, where an unsteady hand will give a panorama of definitely "seasick" quality.

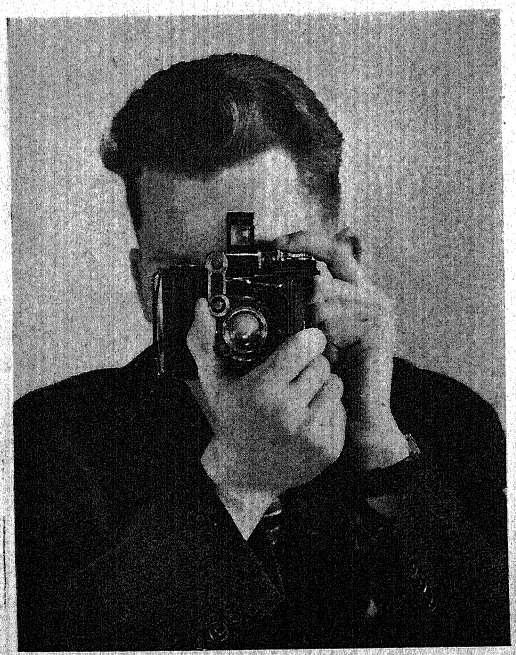


The eye-level position of a miniature camera should be, as shown by this Kodak 35 owner, with a firm but easy grip, with the camera pressed against the face, and with the arms giving upright support

Different photographers have varying abilities when it comes to holding a camera still—some may be able to hold still for a 1/4 second exposure, others not more than



The knee is always a good support—lacking a table, fence, or other absolutely solid camera base

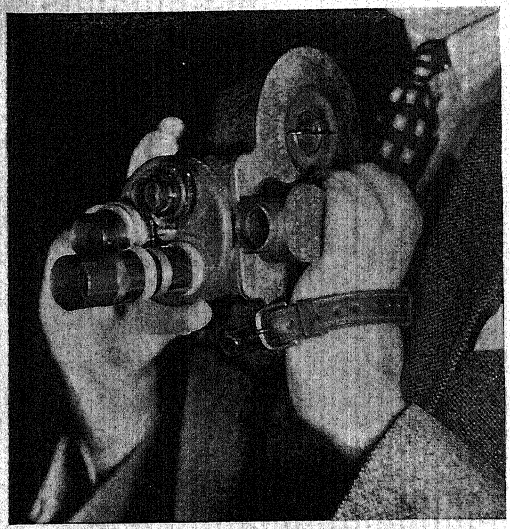


The focusing and shutter release of a folding camera may be controlled as shown with this Zeiss camera. With all such cameras, however, it is extremely important that fingers be kept away from the lens

1/25 second. The best advice is—be on the safe side and do not go without adequate support if possible. The essence of the candid camera is quick action and the addition of a tripod will often impede the freedom of a miniature. But that does not mean that a nearby tree or fence, the hood of a car, or the elbows on knees cannot serve as a good improvised support. And heavier view or studio cameras are never used without firm support, of course. *Wherever possible*, then, use a tripod; if not that, then try for an improvised support of some kind. If a free standing position is necessary, then do not have a death grip on the camera, but hold it easily and pressed against the cheek or body (see pages 31 and 32). The elbows should be held in close to the body to give added support, just as the supporting arm



A cable attachment, as on this Voigtländer, will help to prevent a blurred picture, as smooth release of the shutter is almost guaranteed



It is extremely important to hold the movie camera firmly, when making a hand-held panorama especially. The added weight of a three-lens turret will also make the holding job more difficult. Therefore a hand strap as shown will be helpful

should be held directly under the gun while shooting. And do not take a deep breath during the exposure!

Extra care should be taken when other elements besides the natural shaking of a hand will move the camera. A windy day is time to beware of camera shake. Also when you are moving in a boat, plane, or auto, be sure that you are not resting on any portion (like the plane window) which will transmit the natural vibration of the machine straight to your camera. In this case, hold your camera in a free position and let your body act as a shock absorber.

In addition, learn another thing from the rifleman—how to pull the trigger or release the shutter. This should be done with a steady squeeze, not a sudden jerk.

HOME TOWN NEWSPAPER PHOTOGRAPHY

Dan Sanborn

Staff Photographer, The Lakeland Ledger, *Lakeland, Florida*

It has often been said that a newspaper photographer or free lance worker will do best to start in the small towns, doing local work. Here is an account of the work of a successful home town newspaper photographer, including advice on routine news shots, feature pictures, equipment and technic, and extra work possibilities.

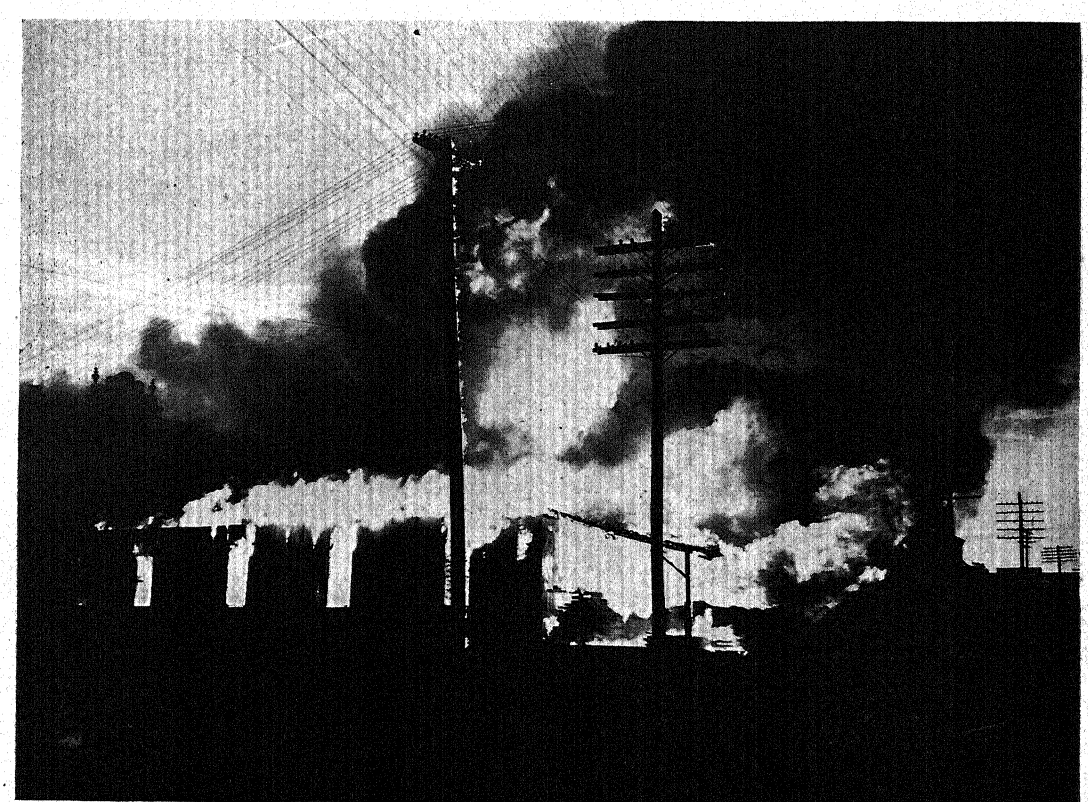
All photos by Dan Sanborn.

See Also Camera Journalism, Free Lance Photography, News Photography

PHOTOGRAPHY on the small, home town newspaper requires just as much skill as on the larger dailies—and a lot more patience and tact. The cameraman for the home town newspaper must be more patient and tactful because he is dealing with people with whom he comes in contact almost daily. Many are his personal friends. It is his duty to make as many friends for his newspaper as possible. He, more than any other employee of the paper, meets and is seen by the most people in the course of a day's work. The very nature of his work takes him before vast crowds, into homes, offices, churches, schools, and any place where news is in the making. Everywhere, people are watching him as the newspaper's representative. As in larger cities, he must follow his quest for news pictures with zeal, but he must do it in a way that will not be offensive.

Aside from making friends for his paper, he must make friends for himself. From these friends come most of the tips that result in timely, on-the-spot pictures. The small newspaper has no city news service on which to rely for tips, nor does it have a large staff of reporters to phone the office when news breaks. The small newspaper's reporters are its friends—policemen, bankers, housewives, doctors, or just plain citizens who are on the alert to call at all times of the day and night.

Many of the tips produce only routine pictures or no picture at all. Often, how-



FIRE. This local lumber plant fire did $10,000 worth of damage and constituted "big news" for the newspaper photographer. DATA: Speed Graphic, fast pan film, 1/50 second, f/4.5, late afternoon

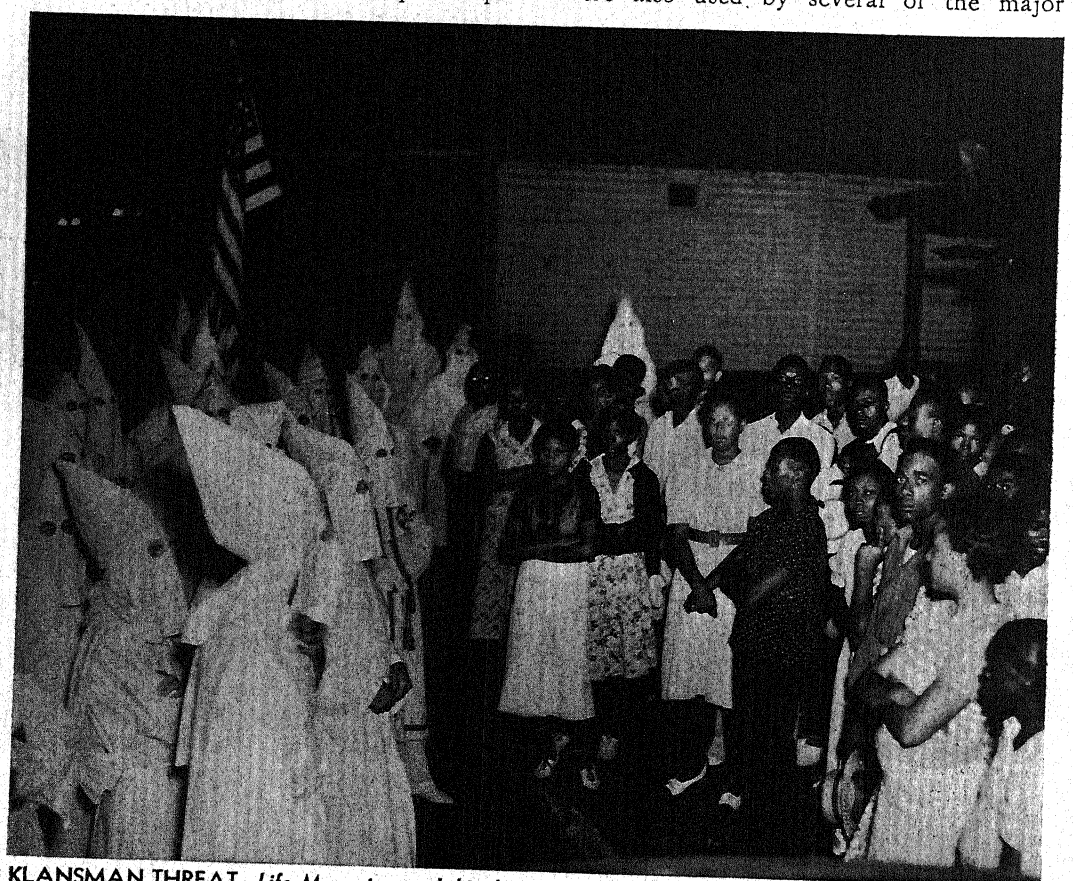


NATIONAL NEWS. When coaches of this Atlantic Coast Line train piled up near Lakeland, Florida, the photographer had a chance to hit the national news syndicates. The Associated Press used this one of a wreck which killed three crew members. DATA: Speed Graphic, fast pan film, 1/135 second, f/16, bright sun

ever, the call results in a bright feature or a dramatic news picture that makes page one. The accompanying picture of the church fire is a typical example of a tip that produced a good news shot. A policeman going off duty at 3 a.m. heard fire trucks race through the town. Locating the blaze, the officer immediately called the photographer at his home.

A housewife furnished the tip that gave the cameraman an opportunity to secure the accompanying train wreck picture shortly after the accident occurred. Three persons were killed when the crack passenger train carrying winter visitors to Florida left the tracks and the picture not only made the front page of the photographer's own newspaper, but was purchased by the Associated Press for its wirephoto service.

The train wreck photo and the pictures of the Ku Klux Klan demonstration are typical examples of big news breaks which might occur in any small town. The Klan pictures made a page in *Life* (Sept. 12, 1938) and were also used by several of the major



KLANSMAN THREAT. *Life Magazine* used this dramatic picture of hooded members of the Ku Klux Klan attempting to influence negroes of Lakeland, Florida. The picture was shot over the top of a car. DATA: Speed Graphic, fast pan film, 1/100 second, f/6.3, 1 flashbulb

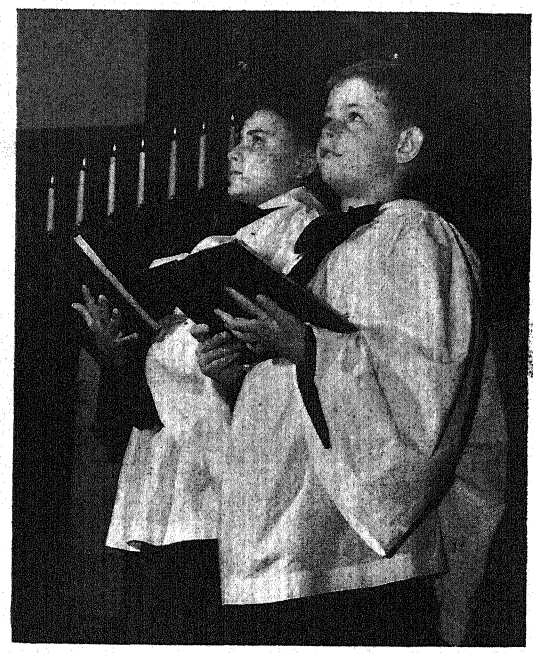
news picture services. The tip on the Klan demonstration came in the form of an anonymous telephone call—probably from a member of the hooded band. He didn't say much—just that "something will happen tonight on the north side, so bring your camera." It was all very mysterious, but the photographer and a friend took a car and began driving throughout the north side of the small town. Early in the evening they ran across the hooded and masked men as they gathered on a vacant lot, and began shooting as the Klansmen marched through the Negro section of the town. One of the pictures used by *Life* showed the Klansmen warning a group of Negroes against outbreaks of violence, which a spokesman said prompted the demonstration. Another was taken as the Klansmen watched flames consume a gasoline-soaked cross.

ROUTINE SHOTS

Routine news picture assignments are plentiful on the home town newspaper, but the photographer must be alert to sense big news when it breaks. By far the greater part of the cameraman's work on the small paper is picturing every-day events in his community —the dedication of a new post office, the arrival of a noted speaker, the tea at the local woman's club, the Jones family's new home, a Boy Scout getting a merit badge, or any number of similar local happenings.

But even these routine pictures can be made interesting if the photographer exercises his ingenuity. An unusual angle or dramatic lighting will often give a "lift" to a picture that would otherwise be commonplace and uninteresting. The two choir boys are examples of how routine subjects were handled in such a way as to command attention. Every home town newspaper gets hundreds of requests for pictures of the cast of school or church plays. And every editor and photographer knows that names make news, so the picture request is usually granted. Most of the resulting photographs are pretty much the same.

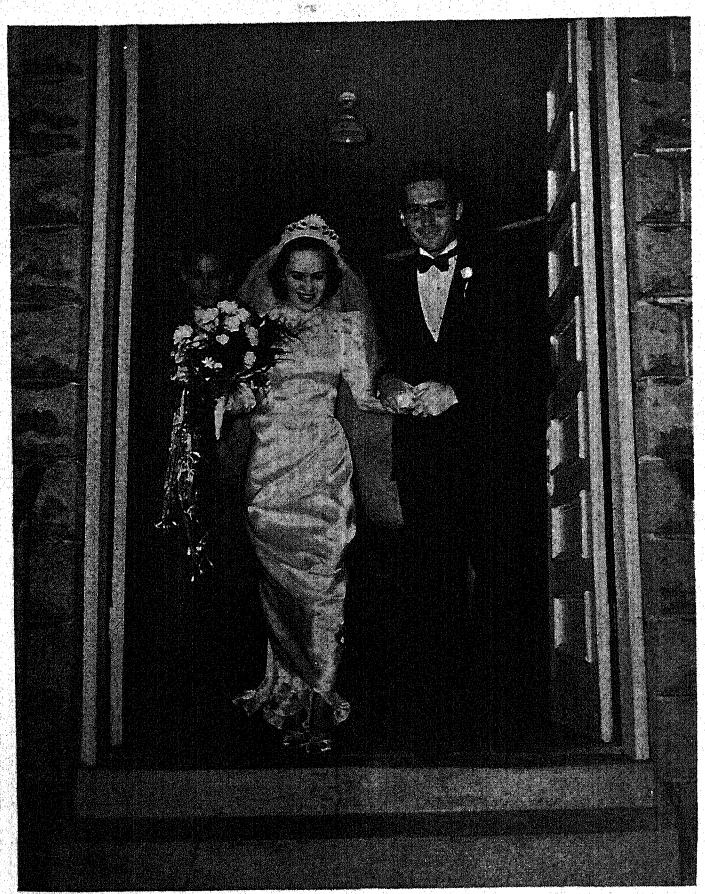
The young choir boys were photographed as a front page Christmas illustration. A low angle and two-way flash lighting made a picture that broke away from the routine arrangement.



PICTORIAL. This carefully posed shot of choir boys was used on the front page as a Christmas illustration. DATA: Speed Graphic, 1/200 second, f/22, 2 flashbulbs

Society News. Society page work for the home town paper is just as exacting as on larger dailies. Readers are as critical in the small town as elsewhere. Too much emphasis cannot be placed on this subject. Weddings produce the most pictures for the woman's page. Other sources are large parties and dances and newcomers to the community. Many home town newspapers now make a practice of photographing all new families for the society section. Informality is the keynote in pictures of this kind. Usually the picture is of the wife and children, but often the husband is included in the family group. Most of the photographs are made inside the home, but in the summertime informal outdoor groups help to give variation to the pictures.

In covering weddings, it is best to snap the bride and groom as they leave the church or home. Since they are apt to be in shade or shadows, a flashgun should be used. If there is a reception afterward, the photographer has an opportunity to secure many informal pictures as the bride and groom cut the wedding cake or as the bride tosses her bouquet to the bridesmaids. And the at-



JUST MARRIED. A bride and groom emerge from the church, making a perfect wedding picture. This is typical of the unposed type of local wedding photograph. DATA: Speed Graphic, fast pan film, 1/200 second, 1 flashbulb

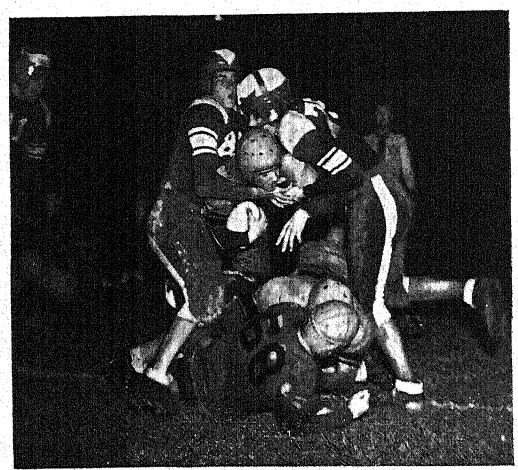
tendants should not be forgotten. A group picture can be made either at the church or at the reception.

Every town, no matter how small, has periodic dances and parties. Following the pattern of the party pictures popularized by *Life* magazine, the photographer on the small paper can secure many interesting shots at these affairs. Again informality is of paramount importance and the photographer should guard against posed pictures. If the people at the party are in costume, the results are doubly interesting. An example is the barn dance in a typical small town. All of those in the picture should be prominent in the community.

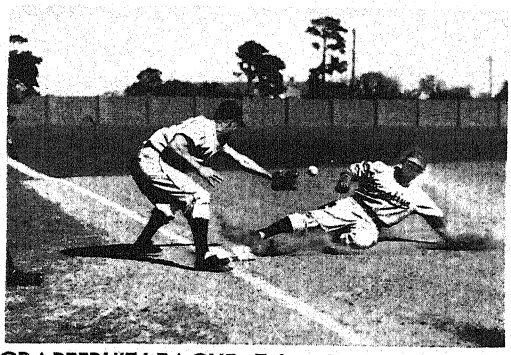
Sports. Sports photography is perhaps the most interesting and most difficult of all for the cameraman on the small paper. The larger newspapers usually have men who specialize in one branch of photography, but the home town paper has only one cameraman, and he does it all. There are always baseball, football, and basketball games to cover, as well as golf matches, swimming events, hockey, and many other sports. Interest in local sports is usually very strong and more and more papers are making sure that adequate picture coverage is given of all events. Pictures of local players in action create genuine interest on the part of the subscriber and help materially in building good will. The method of taking sports pictures is the same as on large papers, but with emphasis placed on local interest.

FEATURES

The three main kinds of pictures found in small newspapers are general news, sports, and society. To round out a full program of



NIGHT GAME. Night games add to the troubles of a home town newspaper photographer as close-up flash work is necessary. Here is a shot of a high school game. DATA: Speed Graphic, fast pan film, 1/200 second, f/8, No. 5 flashbulb



GRAPEFRUIT LEAGUE. Taken during an exhibition game at Lakeland, Florida between the Detroit Tigers and Brooklyn Dodgers. Notice the ball in mid-air. (The runner was safe.) DATA: Speed Graphic, fast pan film, 1/1000 second, f/6.3

picture coverage for his paper, the small town photographer should give thought to human interest, scientific, and pictorial subjects. These can be found in every town with little trouble and should not be overlooked.

Children and animals, of course, furnish the most material for pictures with human interest and the observant photographer will seize every opportunity for shots of this kind. Pictures of children are particularly important to the home town newspaper because of the tremendous local interest.

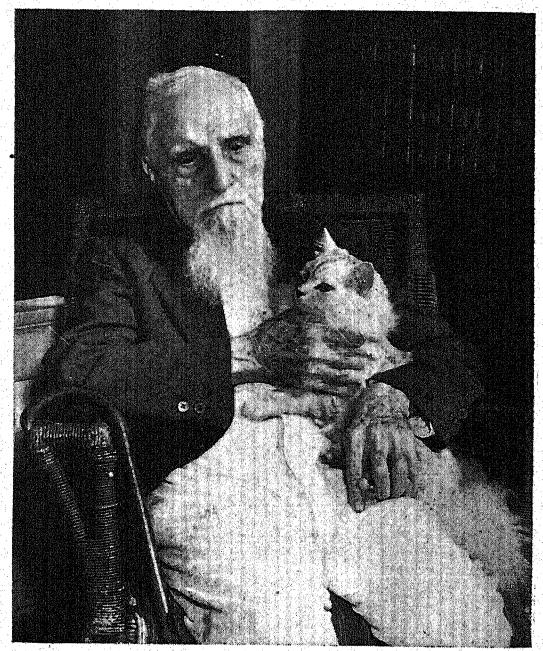
The town's high school or college, through the biology, chemistry or physics departments, are a source of scientific illustrations. And a Sunday afternoon stroll with the camera will produce many splendid pictorials if the photographer looks for them. Familiar scenes take on new beauty if the camera angle is properly chosen and the lighting is correct. The use of filters helps to dramatize an otherwise commonplace picture by introducing cloud effects.

LAYOUTS

Layouts and pictures arranged in a series to tell a story, as in the picture magazines, add variety to the home town newspaper. Even in plants capable of producing engravings only up to five columns in width, layouts covering a full page of eight columns can be made by making a number of separate engravings and assembling them on the page.

To make a full page layout, the photographer, who often acts as engraver, makes a dummy in pencil on a blank sheet of paper the size of the page. The exact dimensions of each engraving are marked on the dummy, leaving space for reading matter under each picture. The reading matter of the layout usually is set in type, but if the photographer is artistically inclined he may letter it by hand on a piece of white paper. Hand lettering lends itself to more artistic layouts in that the photographer can get away from straight lines of cold type. The cutlines lettered by hand may be either pasted on the photograph and the cut made or they may be copied separately on the engraving camera and the film stripped onto a glass with the copy of the photograph. In the former method, the highlight is apt to be in the white paper bearing the cutline, which causes the engraving of the photograph to print gray. When the cutline and the photograph are copied separately, the proper highlights can be preserved in each. Interesting layouts can be handled in an engraving plant capable of producing cuts of approximately five columns in width.

Before attempting a page layout, it would be wise for the photographer on the small newspaper to experiment with a panel of pic-



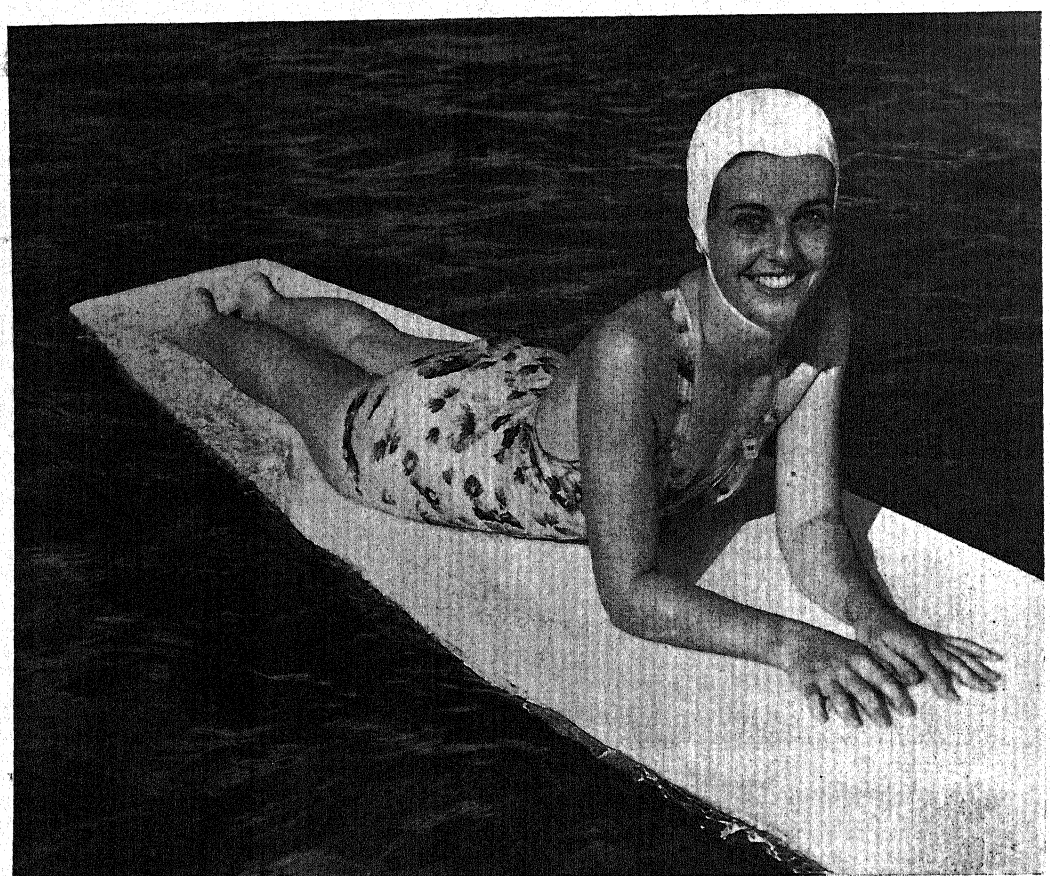
OLD MAN AND CAT. This interesting pictorial photograph shows a longtime resident of Lakeland, Florida—taken on his 100th birthday. DATA: Speed Graphic, fast pan film, 1/200 second, f/22, 2 flashbulbs

tures extending eight columns across the top of a page. These are comparatively simple and add materially to the appearance of the paper. The pictures should be related and if possible arranged in sequence to tell a story. All of the cuts should be the same depth, but can vary in width. Three to four pictures will make a nice panel. A vertical strip of pictures related to the same subject and separated by short cutlines is also recommended.

The most frequent criticism heard of the engravings produced in one-man plants is that they have a tendency to be gray and indistinct. This is caused by failure to give the photograph sufficient flash when copying, improper development of the negative, or shallow etching. Often the photographer himself is at fault. A gray, flat print will not produce a good cut and extra contrast is desired. A good rule is to print normal negatives on contrast paper. On the other hand, the photographer should avoid a print in which the whites are blocked up and the blacks are too solid. A little experimentation will produce the quality desired for best results.

EQUIPMENT

The Speed Graphic is standard equipment for most photographers on home town newspapers. The 4 x 5 size is most popular, with 3¼ x 4¼ next. Some use the Graflex. Few miniatures are used because most papers lack the proper darkroom facilities for handling the small negatives fast enough to meet deadlines. However, some photographers prefer the small camera because it is easy to carry with them at all times. This is particularly true in the case of men who act



LOCAL FACES. This picture of an attractive high school student was used as part of a layout on the opening of the local swimming pool for the season. DATA: Speed Graphic, fast pan film, 1/135 second, f/22, reflector at left

both as reporters and photographers. They find the larger cameras too bulky to carry with them and depend on the miniatures.

In connection with high speed flash work, particularly in the field of sports, many photographers in the smaller towns are equipping their Graphics with flashguns synchronized with the focal plane shutter, giving them exposures up to 1/1000 second. The trend toward night sports events in the smaller localities has made this step necessary on the part of photographers who seek to keep abreast of the times.

Due to its simplicity of operation, the auto-focus enlarger is found in most darkrooms. Many use homemade equipment. The most popular film developer for those who use the Graphic is D-72, which is also used for paper development. The choices of film and paper are many and varied. Darkrooms are usually small and compact. Most darkrooms are combined with the engraving room to save space and speed up operations.

EXTRACURRICULAR

Because he is known to so many people in his community, the photographer on the small newspaper has many chances to make extra money by selling reprints. Weddings and group pictures offer a splendid opportunity for the man who is alert. Some states require newspaper photographers to take out a license if they sell their pictures. Most news cameramen take out the license, which entitles them to do commercial work of any kind.

Through the credit line under his pictures, the home town cameraman soon finds that persons desiring photographs think of him first and many nice orders can be secured. Most papers allow the photographer to do extra work in his spare time, as well as sell prints from negatives made for publication.

The large news picture syndicates and picture magazines are also a good market for new and unusual shots. Big news breaks are few in the average small town, and the photographer should concentrate on interesting features.

Every picture should be regarded as having a potential sales value and the photographer who follows through usually gets an order. It's worth many times the effort.

HORSE AND HORSE RACING PHOTOGRAPHY

Bert Clark Thayer

Photographer of Horses; Author of Horses in the Blue Grass, Jinny: The Story of a Filly, *and other books*

Just as a cat or dog photography is a special field, so is the photography of horses. And it is discussed here from all points of departure—the conformation picture, jumpers, polo and hunting scenes, saddle and harness horses, portraits of famous mounts, appeal shots of work horses, and photography at the race track.

All photos by Bert Clark Thayer unless otherwise credited.

See Also Dog Photography, Rodeo Photography

BREEDING FARMS and race tracks, horse shows and hunts—wherever there are horses, there are scenes with the action, the excitement, the human interest, drama, tragedy and beauty that make real pictures. Although it helps to have a horseman's viewpoint, the only really essential requirement is that the photographer have a love and understanding of horses. If he has a real feeling for horses, he will be able to develop the knowledge that is necessary to capture the qualities of the various classes of horses.

Different technics are needed for the several classes: racers, hunters, jumpers, harness, saddle, and work horses. In each of these classifications there are innumerable pictorial variations possible.

THOROUGHBRED RACERS

Breeding farms offer the biggest opportunity for the photographer. Here he has a chance to picture that most beautiful of horses—the Thoroughbred racer.

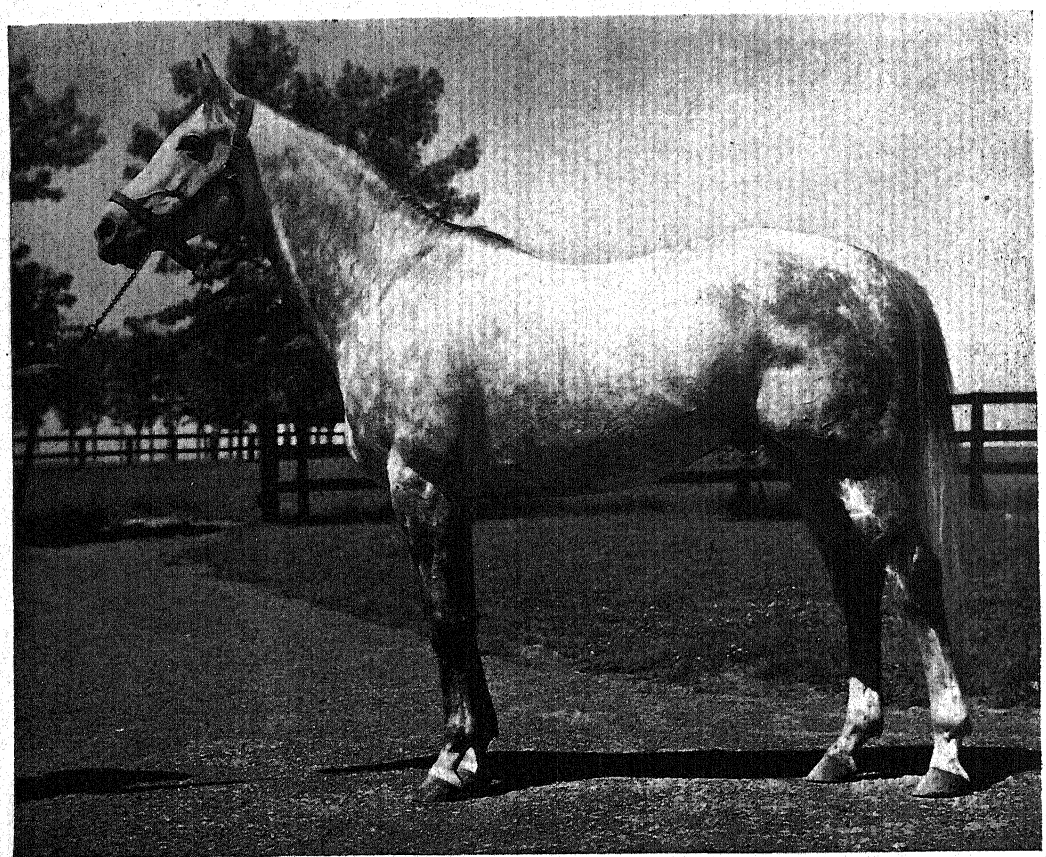
The Conformation Picture. The conventional pose for the Thoroughbred is the strip or conformation picture. Breeders and men who know horses probably prefer this to any picture that is made.

There are two problems involved in this picture—the position of the horse and the background. Backgrounds are difficult because it is almost impossible to persuade a trainer to take his extremely sensitive and nervous animal away from the stable. Thoroughbreds follow quite a strict routine when they are not racing—they are taken for a work-out on the track, cooled out on a walking ring, then groomed, blanketed, and kept in the stable. This calls for most of a pro-

fessional's technical knowledge and a director's ability to cope with temperament—of both the horse and his trainer. A race horse trainer can think of more reasons why *now* isn't a good time to take a picture of his horse. It doesn't matter if you have a written order from the owner, the trainer is the boss, and don't forget it. It's too cold or it's too hot; he ran yesterday or he's going to run tomorrow; he's been put away for the day and can't be taken out. Maybe it's too windy or the flies are too bad. You don't even ask to be allowed to take a picture but come back another day and another. The photographer must not upset the routine. His best bet is to catch the trainer and his horse just after the work-out, when the horse has been groomed but not returned to his stall.

The background is likely to be cluttered with fences, clothes lines, and scattered trappings of all sort. If the horse is dark in color, he can be placed against a white stable wall. Otherwise, the photographer must seek as open a space as the trainer will permit. In any case the backgrounds should be blurred. This calls for a somewhat large aperture opening and for extremely accurate focusing.

Now for the position. I try religiously to avoid the conventional whenever possible, but there is one position in which a horse looks his best and which shows best his conformation. The picture of "Gino" accompanying this article illustrates this point. The horse is standing in a natural position, his weight is well distributed, and it is easy to see his muscle and bone formation. But horses have individuality and personality, and it is as important to try to capture it as it is in human portraiture. The head and neck should be in a natural position and the



GINO—A CONFORMATION PICTURE. The simple stance of this horse is not so easy to obtain—for all legs must be showing, the ears and head must have an alert position, the background must be as simple as possible. In this case, the trainer's hand at the left may be retouched out if necessary



SADDLE MARES AND FOALS. Taken at Winganeek Farm, Lexington, Kentucky. Behind-the-scenes photographs like this are hard to get, but they have the appeal which more formal pictures are apt to lack and are well worth trying for

face turned slightly toward the camera if the horse has a distinguishing blaze or patch on his forehead. When it is impossible to get this exact position, the thing to remember is that there should be some space showing between the legs. There should always be four legs showing in the picture.

The ears must be straight and the tail should stand away from the body slightly. You may have to resort to all kinds of devices to get the ears in correct position. Different horses react to different things, but the best device is a sudden noise. I have found that horses react to music and have often driven my car near the stable. Just before tripping the shutter, I have an assistant turn on the radio in the car. This is sure to pique the animals' interest and cause him to prick up his ears. Avoid too loud a noise as this will startle the horse into losing his position.

The conformation picture should not be made with a rider up and should not include figures at all. Thoroughbreds are often so sensitive and nervous that trainers have to stand close to their heads. If this is necessary, the trainer may legitimately be taken out of the picture in enlarging, or even retouched out.

The horse should carry the lightest equipment possible. Some photographers retouch the negative to remove the halter-shank, but I think this makes an unnatural picture. Any horseman will recognize the subterfuge, knowing that a high-strung Thoroughbred would never be left standing in the open without someone holding him. The camera angle for this shot should be a little below eye level. Shoot so that your lens is level with the horse's shoulder.

Lighting is very important if the conformation picture is to show the horse's

points to advantage. A light sun, coming from an oblique angle, will bring out the conformations best. You may have to walk the horse around the stable yard a number of times before the sun strikes him at just the right angle. Avoid making pictures at noon when the sun casts flat shadows.

In making conformation pictures as well as all formal pictures of horses, I use a 4 x 5 Graflex. Most of my work is done with a 8½-inch lens. The average exposure is



JUMPER. The slight blur of the forelegs and the general "flying" position of the horse give action to this jumping photograph. Pictures which show that the jump has been nicely cleared are best

1/195 second at f/8 or f/11. I always use an exposure meter. Take the reading about 4 feet from the horse to get a correct exposure for his coat. The Graflex allows you to follow the horse's every movement and to catch him just as he will appear on the negative.

The purpose of all this is to one day have a complete library of horse photography for the magazine and newspaper editors, writers of horse books, and as a breeders' reference. Hundreds of the best-bred foals are being photographed every six months, as sucklings, weanlings, yearlings, etc., which, if the hope be fulfilled that some turn out to be the "Discoverys," "War Admirals," and "Whirlaways" of tomorrow, will be a record that should serve many useful purposes.

Behind the Scenes. The conformation picture is just one of thousands that may be made of Thoroughbreds at breeding farms. There is fascinating, kaleidoscopic activity here. My favorite pictures are these behind-the-scenes shots. Here is where the unconventional comes in—where the photographer has the best opportunity to create pictures that express his own feeling for horses. Pictures of the early morning activities, of the work on the track, the water troughs, the grooming scenes, the loading and unloading, the home life of the horses, the awkward, gangling colts and the patient brood mares—these and countless others offer rich opportunities for the open-eyed photographer. Look for new angles, new groupings of horses and interesting new bits of equipment making up the farms. These are the pictures that interest real horsemen.

For these behind-the-scenes shots I use a Rolleiflex. It is easily and quickly handled and when negatives are given fine grain development they permit good enlargement.

JUMPERS

Jumpers require a different technic. This class of horse performs in the show ring and also at field and cross country meets. In the ring, where every small point is counted for and against the horse, the average jump is 3 feet 6 inches to 4 feet. In the field these animals must take brush jumps, post and rail jumps, and brick wall jumps.

There is a conventional picture for the jumper. It catches him in mid-air in that breathtaking moment when he has cleared the jump and before he has landed. It requires a fine degree of synchronization on the photographer's part to catch just that one instant. As soon as you see that the horse is going to clear the jump, take your picture. For the first few times, you will probably be so excited that you will jar the camera, or you will gasp, gape, and forget all about your shutter button until the horse has jumped out of the picture. With a little experience, though, you will know the exact moment to release the shutter.

Your viewpoint should be at about a 45° angle, about 25 or 30 feet away, with the horse jumping towards you. This angle is better than a 90° angle because you will be able to show all four of the horse's legs.

Use the highest shutter speed your camera has. With Tri-X Pan in my 4 x 5 Graflex I use a 1/1000 second to stop jumpers. In this, as in all horse photography, I use the fastest film available. It is not essential to stop the horse completely. In fact, such pictures usually have a static look, rather than

that sense of powerful movement. If a little movement is present in the picture, usually in the front hoofs, the impression will be a more natural one and more suggestive of speed.

In these pictures, as in almost all horse pictures, the photographer must depend on daylight because *the flare of flashbulbs frightens the horse and often causes spills.*

The photographer who is making pictures for horsemen will not be interested in catching spills at the jumps. He leaves these to the newspaper men, who depend on such for their spectacular news shots. However, the technic is the same whether you are trying to capture a picture of a perfect jump or a picture of a dangerous spill—be ready, steady, and quick!

SADDLE AND HARNESS HORSES

There are two types of saddle horses—the three-gaited and the five-gaited. The three gaits are the walk, trot, and gallop; the additional two gaits are the slow gait and the fast gait or rack.

The saddle horse photographs best in his trot. Here his leg action is synchronized gracefully and powerfully. Legs are coordinated and off the ground in their proper positions. Catch the horse in a trot with one or two feet off the ground, his head held high. Try to get the ears forward in an alert position and the tail in a graceful swing. As for still pictures, the five-gaited American saddle horse with docked tail is always pictured in an extended pose, with his fore and hind legs spread apart in the manner used in horse shows.

Backgrounds are simpler here because the riders are usually up and have control of the horses. The photographer can arrange pictorial backgrounds, such as skies with dramatic clouds, etc. The camera angle can be a little lower in order to emphasize the raised legs and head of the horse. You should take care to have the rider's clothes well-arranged in these pictures, as a slouchy habit will detract from the finest horse picture. Fine equipment is also an additional attraction in these pictures, particularly when it contrasts in color with the horse.

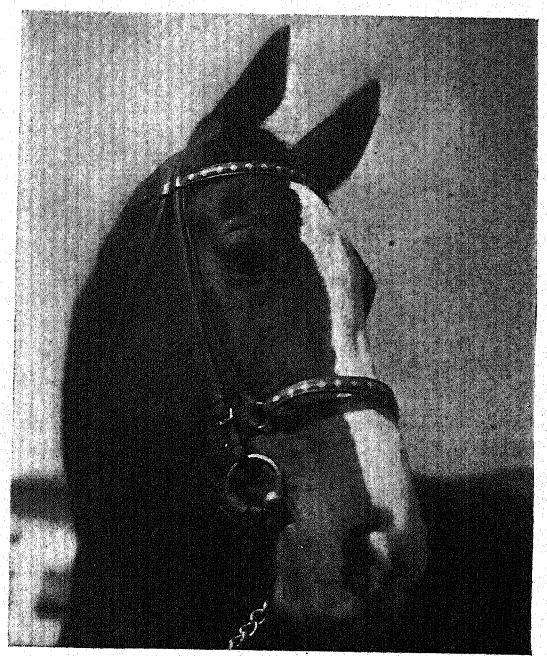
Personally I do not care to photograph the saddle horse because I consider the animal artificial. The great temptation to photographers who specialize in this field is to retouch the negative in such a way that anybody's nag looks like a finely bred animal. Real horsemen realize and resent the superficiality of this.

Harness horses or trotters may be photographed with or without their vehicles. Both single and double horse teams make splendid pictures, though double horse teams are more difficult to catch in coordinated motion. Opportunities for making these pictures are somewhat rare. In the East there is the Grand Circuit, which includes the Hamiltonian and other races at Goshen, N. Y.

The harness horse may be pictured in a pose similar to that of the saddle horse, except that in this case the feet may be raised even higher, his head further back, his mane flying in the wind. There is speed and action in this type of picture. The exposure must be fast. Usually a shutter speed of 1/450 to 1/750 second, depending on the distance from the camera, will be necessary.

PORTRAITS OF HORSES

So far, except in the suggestions of behind-the-scenes pictures at the breeding farms, we



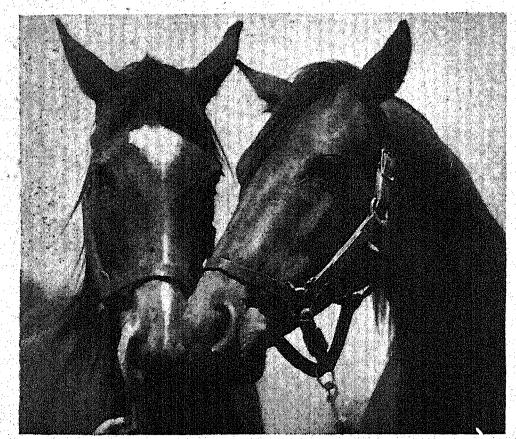
GOOD GAMBLE. Here is a good head portrait—showing the graceful curves formed by a slightly turned neck

have spoken of full length pictures. This has neglected one of the most attractive of horse pictures—the head portrait.

Horses are quite a good deal like human beings as far as personality and individuality are concerned. The expression on a horse's face changes according to the way he feels. He may look alert or bored, happy or dejected. There are any number of factors contributing to the perfect portrait—the expression in the eyes, the tilt of the ears, the nostrils, and the mouth, etc. Lighting has much to do with the expression and the textural effect in the horse's coat. Try to get the sun at an oblique angle for good textural effects.

The standard picture, and an excellent one, shows the horse's head in near profile but turned slightly toward the camera, just enough to show a blaze or mark on his forehead if he has such a distinguishing feature. Sometimes the whole neck is included, sometimes only a portion of it.

By looking for new angles you can create pictures of originality and real worth. Try combining two or even three heads in a picture. Horses' expressions are accentuated when more than one head appears in com-

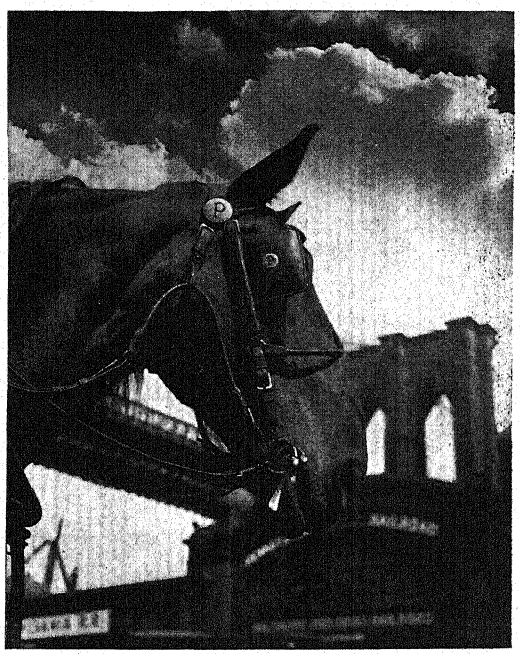


BRUSH-UP AND ANNETTE K. The dam and granddam of "War Admiral," these two horses make an excellent double portrait. Such photographs are just about twice as difficult to take as the single portrait—but well worth it

bination. The expressions may be similar or they may contrast—either way, you have a picture that is different. There is opportunity for remarkable grace in these combinations of two or three heads, particularly when the necks of the horses are included in graceful curves.

That delightful curve in the neck that you have admired in some horse pictures can be obtained by turning the animal's hind quarters a little toward the camera, its shoulders away, and its head and neck turned toward the photographer just enough to show the ears and a little of the offside eye. Do not work too close on these head pictures. Keep the features in a single plane, if possible. Otherwise, your pictures will suffer from distortion.

I use my 4 x 5 Graflex with an 8½-inch lens to get depth of field. The image is not

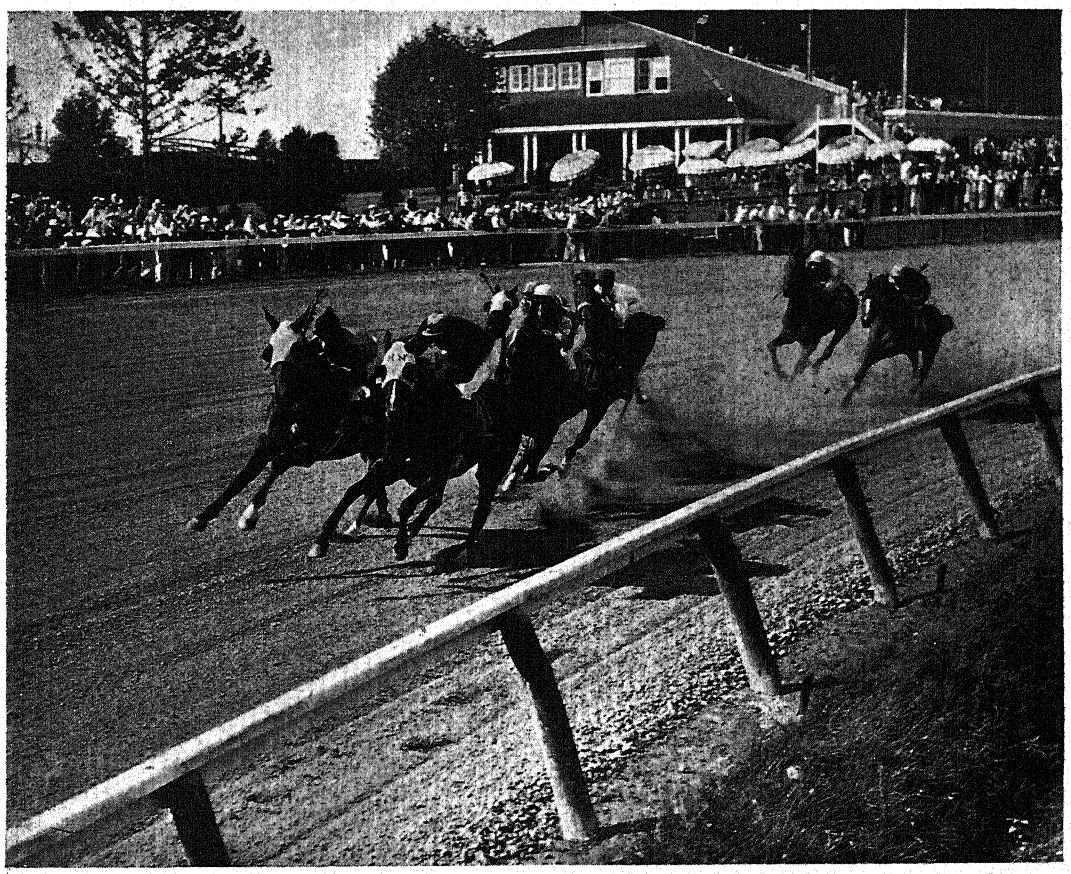


TRUCK HORSE. The patience and appeal of a city work horse is portrayed in this photograph taken in New York's Lower East Side

too large, but may be enlarged and a smaller camera gives distortion. The angle is important here. Keep the camera on a level with the horse's eye. This may mean climbing onto a fence, a box, or a log.

WORK HORSES

The homely old work horse offers opportunities for countless appealing pictures. There is tragedy and humor, courage and despondency, beauty and ruggedness in these old animals. These horses abound on farms. Even in New York City there are



TAKING THE TURN. This view of an exciting race was taken from the inside rail, and includes plenty of background atmosphere and foreground action
Photo, Larry P. Keighley

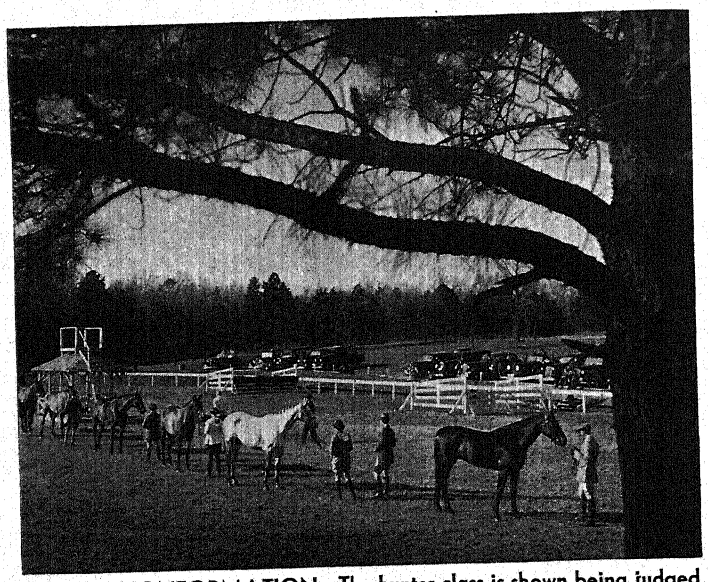
many work horses left on the streets. They offer possibilities for contrast pictures as well as character studies. They draw carts and wagons along the waterfronts. I like to picture them there, along the cobblestones of Front Street or West Street, with the Brooklyn Bridge or the docks in the background.

This is an instance in which the photographer of horses can indulge in odd angles. Since the worn-out old plug has long since lost whatever points he might have had, there is no fear of distorting the huge, ponderous legs and hoofs. A high angle will emphasize the heavy head, the ragged mane. Appealing pictures have been made of horses with their heads in feedbags or wearing blinders. Work horses that have been retired to green pastures are also very appealing. All sorts of possibilities exist here for the imaginative photographer.

AT THE RACE TRACKS

Horse racing has been truly called "the sport of kings." Here is color and brilliance —and a never-ending source of pictures. The first thrill of the saddling, the grooms bringing the horses from the stable, the valets putting the equipment on, the owner at the paddock, the jockeys weighing in—then the parade to post, the tension at the starting gate, the heart-pounding shriek of "They're off!" from the gallery, the long stretch run, and at last the finish.

Perhaps you can arrange to ride in the starter's wagon to get the picture of the start. If not and you want a dramatic upview of the start, get as close as possible, hold your camera considerably below eye level for that dramatic shot, and wait for the starter's bell. Be on guard against someone suddenly stepping in front of your lens.



JUDGING CONFORMATION. The hunter class is shown being judged at a Camden, South Carolina show. Notice the foreground framing—giving this fine pictorial qualities

This, of course, is something of a conventional approach. It has probably been done by all photographers who ever set out to cover a race. If you want original pictures of races, you must work for them. I prefer to make my own race pictures from the stands—with a 16-inch or 18-inch lens on my 4 x 5 Graflex. This telephoto lens pulls the horses up to me and allows me to compose pictures more to my liking. It takes me away from the jam of photographers at the finish line and gives me pictures with a new slant. I sometimes get the crowd in the foreground of these track pictures. This places the picture and gives it atmosphere. The important thing, though, is to vary your shots. With so much rich material it would be wasteful to concentrate on any single angle or any single composition.

Another favorite angle of mine is from the ledge in front of the boxes at Pimlico. From this position I like to train my lens on the horses and "pan" my camera with them for about seventy-five or a hundred feet. Then I take the picture when they reach just the position I want. With this technic, I can use a slower shutter speed and smaller lens opening and get more depth and sharpness in the negative. The background will naturally be blurred, but that in itself only increases the feeling of action and speed in the picture. When working in the grandstand or at an angle in front of the boxes, 1/500 second will be sufficient to stop the action.

COVERING A HUNT

Hunts are just as thrilling as races, and perhaps even more colorful. Here again is a rich field for unconventional pictures. Look for the unusual angles in every activity. The gathering of the hunters, the preparation of the mounts, the hounds in the kennels, the



AIKEN HUNT SCENE. Taken before a drag hunt at Aiken, South Carolina, this low angle photograph is well thought out. Notice the out-of-focus background of pines, attentive hounds in the foreground, and—of course—the graceful pose of both the whip and mount in the center



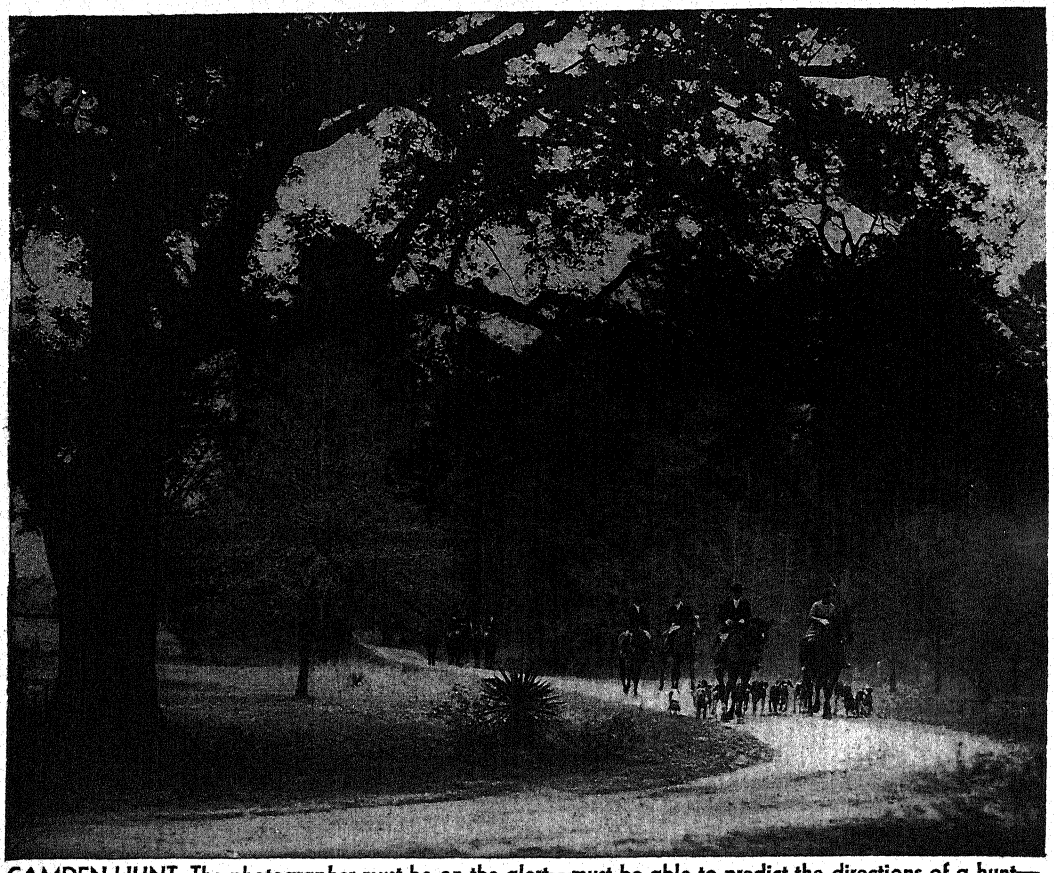
THE KILL. Few photographers will ever be "in at the kill" unless they are horsemen who ride with the hunt. Here, then, is an unusual photograph of the kill at the Warrenton Hunt, Warrenton, Virginia

hunt master and his staff, the mounting scene, the huntsman setting out with the pack, the race across the fields, the jumps, and finally the kill. In all these activities there are hundreds of chances for unusual and exciting pictures.

Covering a hunt is a difficult, sometimes a dangerous business. The photographer who can ride has every advantage over the worker who is forced to remain afoot. I have had unusual success with hunt pictures because I am as familiar with a horse as I am with my camera. By riding with the hunt I have been able to catch intimate close-ups that I would never have seen otherwise. And I've had the unusual good fortune of being in at the kill—something that would happen not once in a lifetime to the photographer who was not riding to the hounds himself. As far as I know, there have never been more than three or four pictures made of actual kills. I've been lucky enough to get two of them—but only because I was able to follow the pack on horseback.



MEADOWBROOK HOUNDS. Here is a quiet hunt scene—with the misty background and framed foreground giving it pleasing pictorial qualities



CAMDEN HUNT. The photographer must be on the alert—must be able to predict the directions of a hunt—before getting photographs like this one of a South Carolina hunt. And, again, notice the framing

I have arranged a special carrying outfit for my Rolleiflex—a strap that holds it tight and keeps it from jostling as I ride. Whatever camera you use, you can make the necessary adjustments for carrying. It is

(Continued on page following insert)



COMPOSITION ANALYSIS for . . . INTERIOR OF RURAL HOUSE

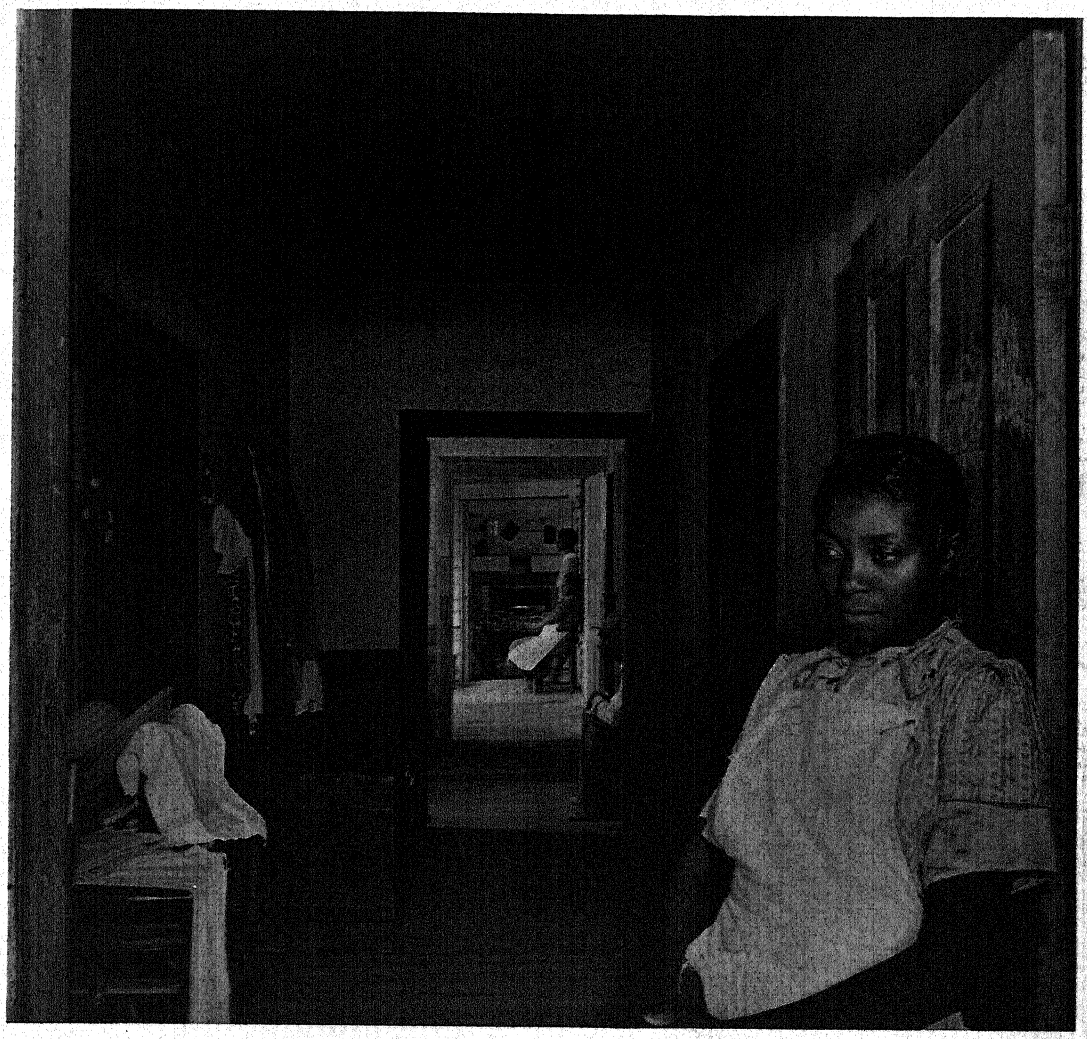
Here is a picture to be looked at slowly. Taken by Jack Delano in the line of duty as photographer for the Farm Security Administration with Roy Stryker, it obviously gives facts about housing and rural living conditions among negro citizens in Georgia. However, it is such an absorbing picture that it can stand on its own merit.

At first glance one sees the girl in the first room singularly detached from the very surroundings the sociologists are out to correct. Then, drawn into the vortex of receding perspective, the eye continues through the doorway into cell after cell of this strung-out dwelling, each time pausing with the relaxed and withdrawn man, woman, and child.

In spite of the scratched paint and worn boards, there is a harmonious personal dignity of the whole which makes one think of paintings of Dutch interiors, with their serene figures. Sometimes the perspective telescoping of the composition in deep space gives an optical illusion. The miniature scene in the most distant room has the effect of a picture or mirror on the wall of the first large room. Again, all of the architectural lines seem to be driving to the central vanishing point just above the center of the black fireplace rectangle.

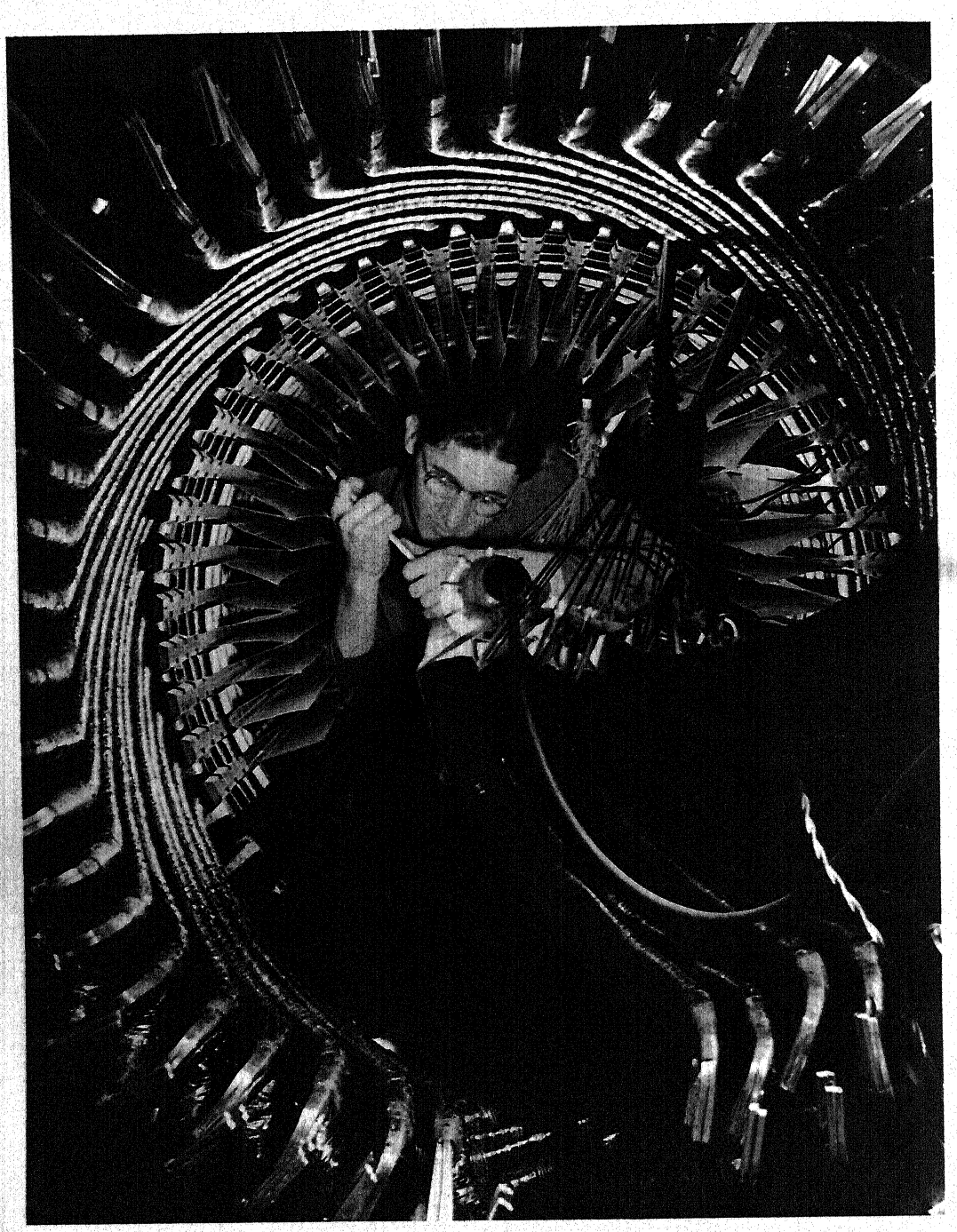
The different lighting in each room as one continues through doorway after doorway increases the subtle detachment. On the left, the clothing, hat, sewing machine, and the trunk balance the quiet close-up sculptural figure of the girl. One imagines that the photographer had asked the folks to be in the various rooms while he shot the picture. This they have obligingly done, each meanwhile going into a natural reverie which welds the picture into an emotional unity, intensified by the architectural unity of forms in the receding space.

Barbara Morgan



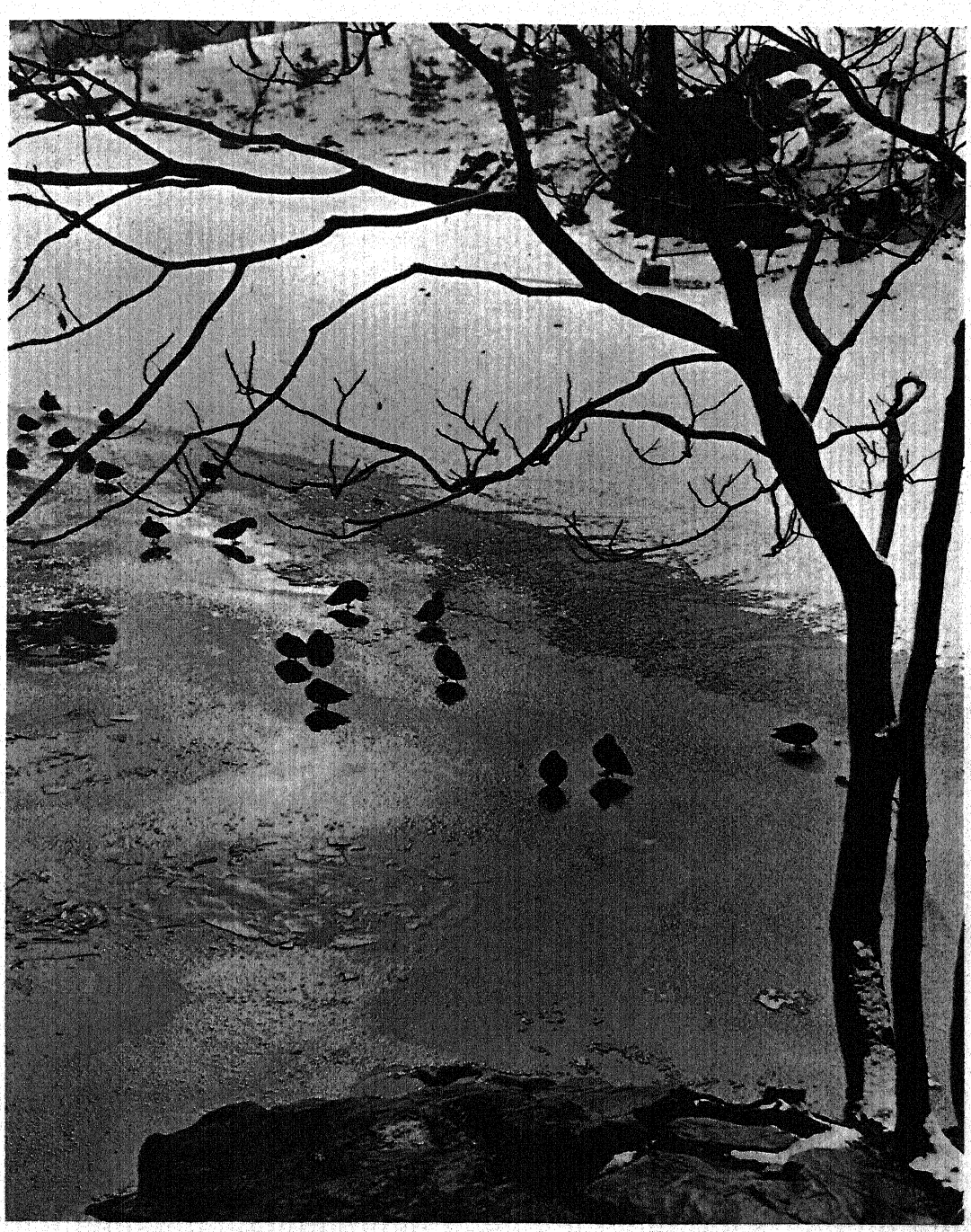
INTERIOR OF RURAL HOUSE — **JACK DELANO**

Showing skillful use of deep space with a combination of daylight and flash. The figures add to the distance effect by contrast in sizes. Taken in Greene County, Georgia, for the Farm Security Administration



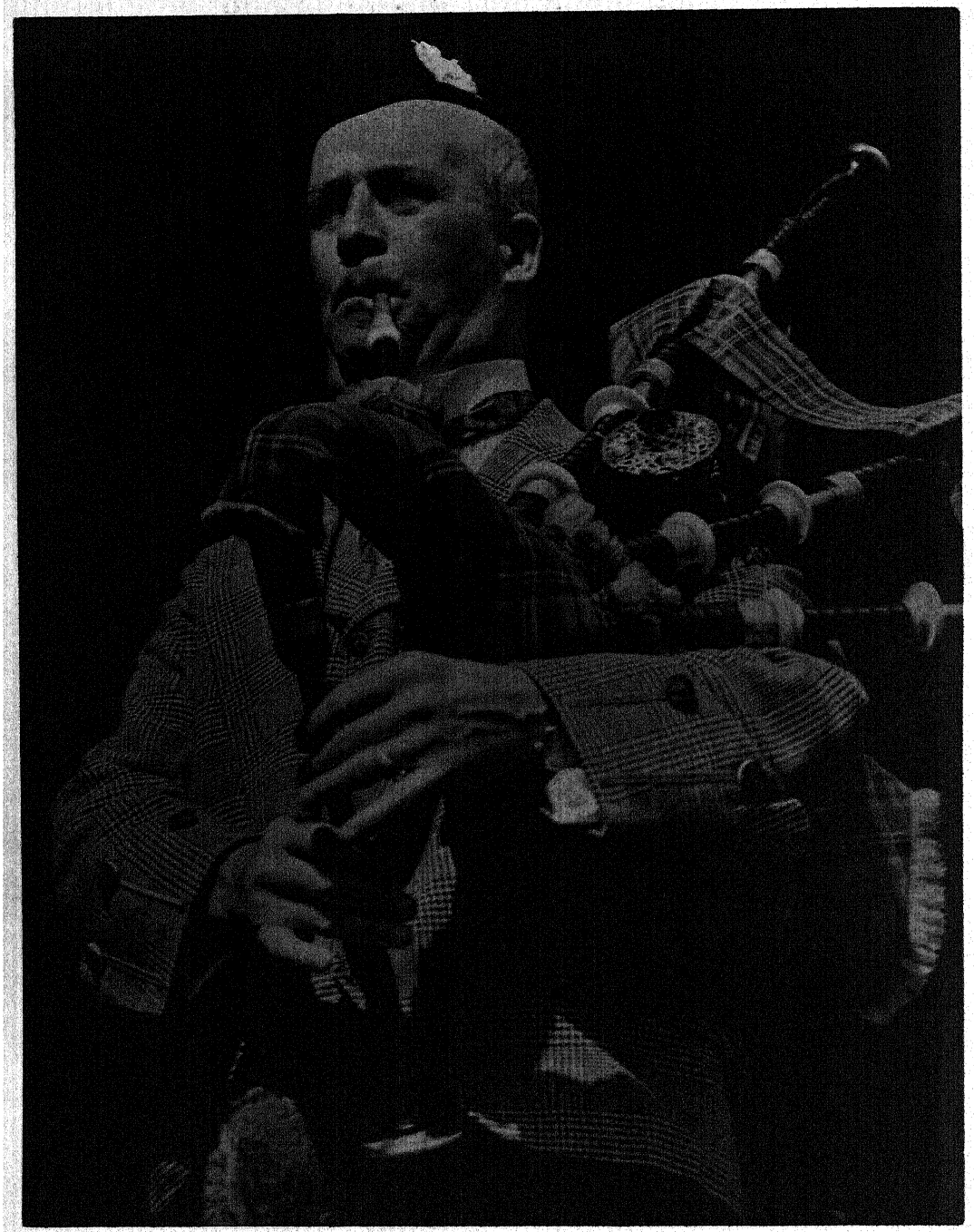
GENERATOR **GEORGE E. HOLM**

Taken for Westinghouse, this shows an employee in one of their plants working in close quarters on a 3750-kilowatt turbine generator for the U. S. Navy. DATA: Deardorff 5 x 7 view camera, 7½-inch f/4.5 lens, fast press pan film, one 40-watt light in steel guard, one No. 1 photoflood at right



EARLY THAW — **ULRIC MEISEL**

Here is an interesting pattern, with the trees and birds silhouetted against white snow and glaring ice and water. There is the feeling of coming spring in every detail. Notice, too, that the tree branches have framed the scene—but the background of snow is still important



BAGPIPER **KURT LUBINSKI**

The excitement of a piper's music and the swirl of his gait have been caught in this carefully-posed indoor shot. Taken with two No. 1 photoflood bulbs against a plain black background

(*Continued from page preceding insert*)

essential that you be able to get at your camera with the least possible effort. In following the hunt you will come upon pictures so quickly that there will be no time for clumsy, time-wasting adjustments of camera, filter, meter, etc.

If you cannot ride with the hunt, there is no need to give up hope for good hunt pictures. Often you can arrange to be driven by car to the fields where the hunt is expected. The master or huntsman will tell you beforehand where he thinks the pack will go. You should learn to anticipate. If you are able to become familiar with the terrain beforehand, you will have a great advantage. Pick the spots for dramatic close-ups. There will be jumps, spills, and thrills aplenty before the day is over.

THE HORSE SHOW OR POLO MATCH

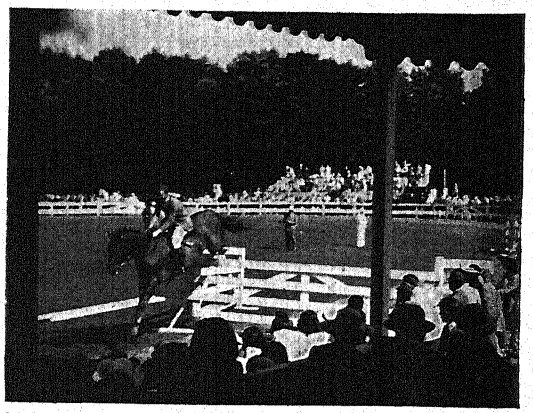
Horse shows range in grandeur and magnificence from the spectacular National at Madison Square Garden in New York City to the small county shows that are held all over the nation.

At Madison Square Garden you are not allowed to make pictures in the ring, nor to shoot flashbulbs when the horses are performing. I use my Rolleiflex here. By using the fastest film possible and opening my lens wide, I am able to catch most of the action with only the lights provided in the ring. This small camera is particularly useful in getting the human interest pictures at outdoor horse shows—the grooms and stable boys and bee-like activity going on behind the scenes.

Different circumstances will govern your horse show pictures and it is difficult to prescribe any rules. Some of the circuit horse shows are held in the daytime, some at night, a few indoors but mostly outside. All these things will determine the kind of work you are able to do.

Successful polo pictures depend mostly on luck. The polo field is not like a race track, where you know beforehand the spots most likely to provide the telling shots. The photographer cannot be on every side of the field at once. He must choose his spot and just wait and hope that he gets a lot of action within lens range. He must definitely stay behind the boards here as there is no edging out onto the field.

In this game every bit of the photographer's skill is called upon. He must be able to focus quickly and release his shutter at just the right instant. He must use his highest shutter speed—1/1000 second if he has it—and the fastest film available. A low angle makes good polo pictures. Beautiful com-



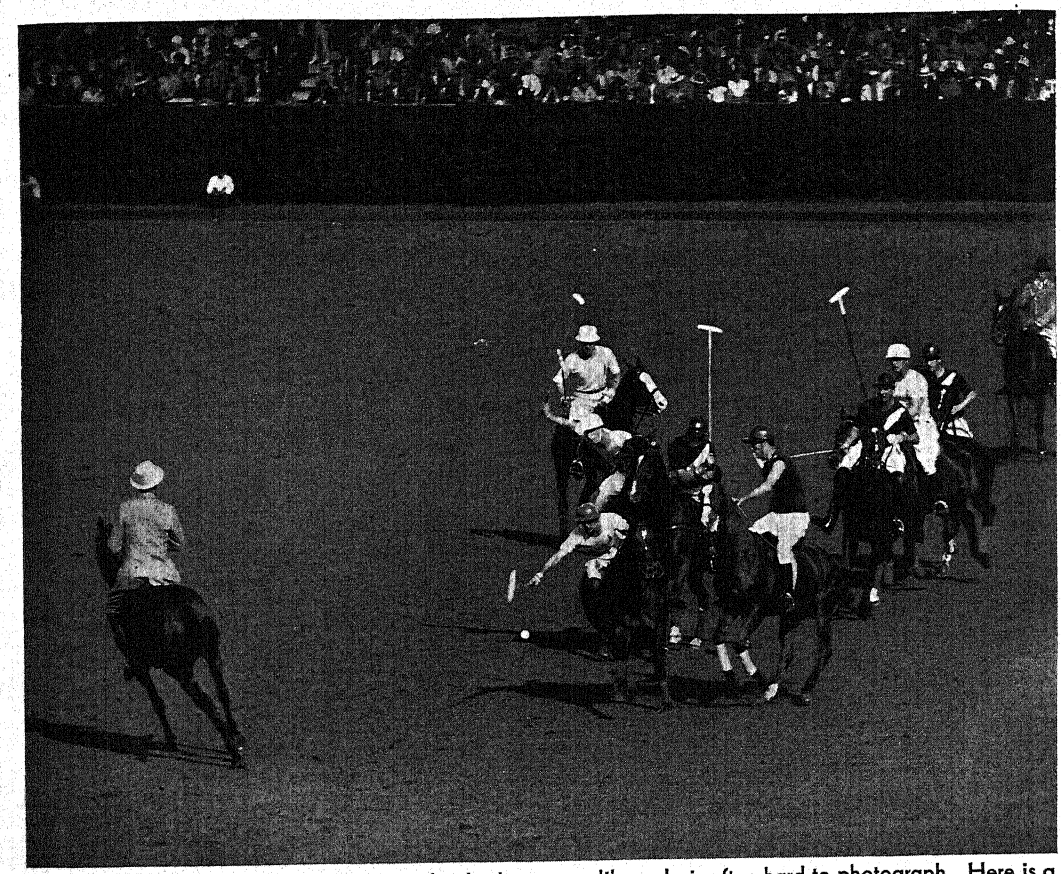
HORSE SHOW. An outdoor horse show—such as this one in Fairfield, Connecticut—is a good deal easier to photograph than an indoor one. The photographer must know which horses to photograph and when and how to do it. This is an atmosphere shot—including the audience

positions are possible, with the mallet swinging in a curve and the ponies charging and swerving, with their feet cutting the grass or slicing the air.

As in all sports involving horses there are interesting behind-the-scenes shots in polo. Horsemen love every moment of the game and like to see every moment pictured—the arrival of the players, the unloading of the tack, and the players' kit being set up on the sidelines, etc.

FINISHING PRINTS

Retouching of negatives presents more than the ordinary problem. For a photographer of horses, retouching becomes a matter of ethics. By using this device he can change the veriest nag into a handsome Thoroughbred. But after he has done this a number of times, his pictures of real Thoroughbreds lack significance. Horsemen come to distrust his work. It is far better for him to forego retouching altogether than to risk his reputation.



POLO AT MEADOWBROOK. A fast, hard-riding game like polo is often hard to photograph. Here is a shot taken from the stands at Meadowbrook with a long focus lens

Backgrounds are a different matter, though I like to retouch them as little as possible. There are times, however, when retouching of backgrounds is absolutely necessary. The extent to which this is carried is a matter of taste.

Panels and Murals. Pictures of horse scenes lend themselves beautifully to panels and murals. Enthusiastic horsemen often like murals in their homes or their playrooms. Race tracks sometimes employ huge murals as part of their interior decoration.

The largest continuous picture mural that I have ever made from a single negative is in a home in Montpelier Station, Virginia. It stretches for nineteen feet across a wall—a pictorial shot of a group of mares and foals in pasture. Another of my murals is at the Hollywood Race Track in Los Angeles. It is 105 feet long, but is made up in sections, with breeding farm scenes and race track shots.

HOUSE AND HOME PHOTOGRAPHY

Theodore Fisher

Architectural Photographer, Denver, Colo.

Almost every photographer—at one time or another—takes exterior and interior views of his home. If well planned, these can be excellent architectural shots, giving a real idea of the design and atmosphere of the house. A man who makes his living taking pictures of houses tells about equipment, lighting, camera position, photographing details, and the problems of furniture.

See Also Architectural Photography, Interiors

IT IS WELL to remind the tyro that his success in photographing homes will depend not only on skill but also in large measure on his sympathetic approach. His pictures at their best should be an interpretation of the architect's work, rather than a mere record. The greater his appreciation of the fundamentals of building and interior decoration design, the better his personal equipment.

The photographer can best test his home photography technic by comparing his own exposures with illustrations in the best house and garden and architectural journals—*Better Homes and Gardens* and the *American Home*, *House and Garden* and *House Beautiful*, *Country Life* and *Town and Country*—to name a few of the outstanding publications. The professional architectural journals such as the *Architectural Forum*, *Architectural Record*, and *American Builder*, of course, cover the entire field of construction. However, in addition to the magazine market there is an excellent outlet for the architectural photographer with materials firms. These buy many pictures showing installations of their product both for their own salesmen, their house organs, catalog, and for their magazine advertising. Best of all, there is still no overcrowding among such photographers, so that he who would master this particularized field will find plenty of room.

EQUIPMENT

While the lens end of your camera is important, equally vital is the other end of the bellows, the groundglass. There is no more essential educational influence in the architectural photographer's beginning or most advanced development than this viewing glass. For when he sets his camera on the tripod, racks out the bellows, and opens the lens shutter, the image on the groundglass indicates at a glance the intensity of light on his subject, so giving a key to exposure, the pattern of light and shade, and the other phases of his compositional problem.

In this age of fine grain films and fine grain developers, the original size of the negative is immaterial, for clear and snappy 8 x 10 or larger prints can be had from good small negatives by projection printing which are impossible to distinguish from contacts of the same sizes. I do, in fact, occasionally carry my precision folding 2¼ x 3¼ equipped with a super quality lens, using it for memorandum or preliminary shots. I have found this small camera very handy on a hurried trip when I have run out of both time and enough loaded holders for my regular 5 x 7 view camera. Under such circumstances the smaller instrument is reserved for close-up details.

Because of the mechanical exactions of architectural photography, the photographer who wants to take up this picturing of homes and gardens seriously, however, is admonished not to start with his candid camera or any other than a view camera. He can acquire the rudiments only by this method. Space does not here permit the discussion of the mechanical differences of small and view cameras, but it might be remarked that the chief of these is the lack of a viewing or groundglass large enough to compose on and lack of swing back or front adjustments.

My lens equipment for my 5 x 7 view camera is a Wollensak Velostigmat Series I of 7¼-inch focal length, in an Optimo shutter, convertible into 10½-inch for the single elements. When wide open, this lens does not have sharp enough definition for architectural purposes, but as speed is rarely a consideration in work of this type I get what I want by cutting the aperture down to f/32 or f/64. For interiors I use one of the Bausch and Lomb series in a 4½-inch focal length. To those who are about to secure first equipment for architectural photography I would advise the best lenses.

An indispensible part of one's equipment, obviously, is the tripod. To have just one of the usual 56-inch maximum extension is frequently a serious handicap. The home photographer often needs an added foot or two of height, especially when he has a building of considerable height as a subject or when he has both foreground and middle distance to show in detail. Even if he has to carry about a box or folding chair from which to operate, a tripod with at least a six foot extension, if not longer, will prove of great value. The writer, by the way, often works from the top of his car.

LIGHTING FOR EXTERIORS

The first decision in picturing house exteriors is that of the best angle of light. Never if you can avoid it—and for once we must be dogmatic rather than suggestive—have the light directly to your back. The effect of depth or planes, which is such a material factor in achieving realistic and pictorial effects, is determined by angle of light. A cross light, nearly a right angle to the direction in which you are pointing your

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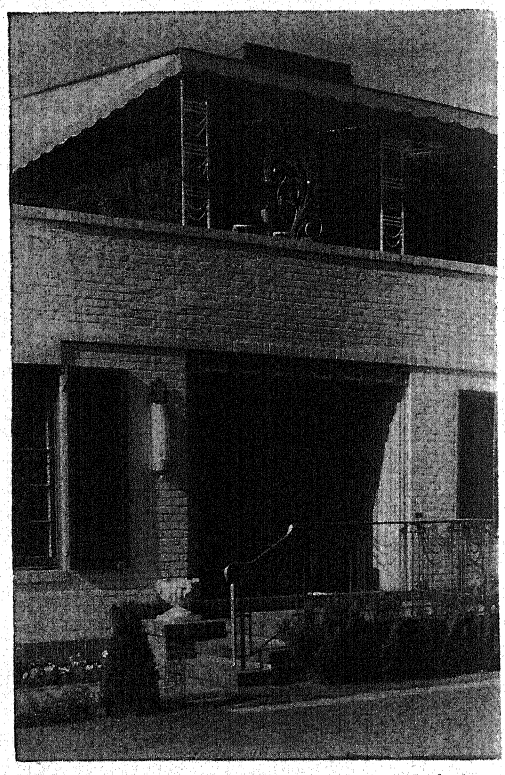


FIG. 1. This illustrates the use of sharp angle lighting to bring out the quality of brick and details. Such an angle is also needed when getting the details of a clapboard exterior
Photo, Theodore Fisher

camera, is what you need. And too, catch your subject in early morning or late afternoon rather than in garish midday unless, of course, the intense contrast is what you want. This side illumination of more level light, in laying shadows across an otherwise uninteresting foreground or middle distance, often aids in the pleasing distribution of light and shade, imparting a sparkle and brilliance to all foliage. This sharp angle of light will give us the surface quality of materials such as stone, brick, wood, or stucco. Figure 1, a detail of a white painted brick house, illustrates this point.

For comprehensive house pictures the relative angles of the two sides should, in general, favor the principal façade with the most light on it, the other being in half light or shadow. The orientation of a house, however, often places limitations on the photographer, such as one with a north frontage that will get direct light only in the early morning or late afternoon of mid-summer. We can't always wait until this turn of the year, so we will be fortunate under such conditions if there are any columns, pilasters, or other projections to catch the sun and so break up the shadowed mass. A light colored walk, paved terrace, or gravel drive reflecting the light can assist too in brightening such a shadowed side.

CAMERA POSITION

With the time of day and angle of light first decided upon, we fix the exact position of our camera. This should be far enough back from the house so that roof lines and the other elements of perspective are not distorted. Another point is the relative size of the house image on the plate in proportion to the setting or surroundings. The interest of the adjacent yard or garden will, of course, have a bearing on this. How much foreground and how much top or sky? As a general rule we can say that the top and bottom should either be about equal or foreground given more prominence (Fig. 2). There is a psychological reason in this suggestion in that we are usually more conscious of the earth around us than the sky over us.

Composition. We might offer the compositional suggestion that lines leading into your picture, such as a walk or driveway, carry the eye from foreground to the house in middle distance. This is especially true of a curved line (Fig. 3). Likewsie a gateway which serves as a frame or setting gives unity and interest. Figures carefully placed can be made an enlivening element in architectural exteriors. But they should be placed far enough from the camera so that they are not readily identifiable and carefully planned as to scale. They should not face the camera or be posed so as to indicate any consciousness of it. Two or three people in a garden discussing a planting or standing or seated in conversation on an entrance porch will be effective.

Focal Length. What about the focal length of the lens to be used in such general views? If intervening objects—such as buildings or a line of trees—compel working closer than we would otherwise like, we must with regret select a short focal length so as to secure scope at close range. If we are free to pick

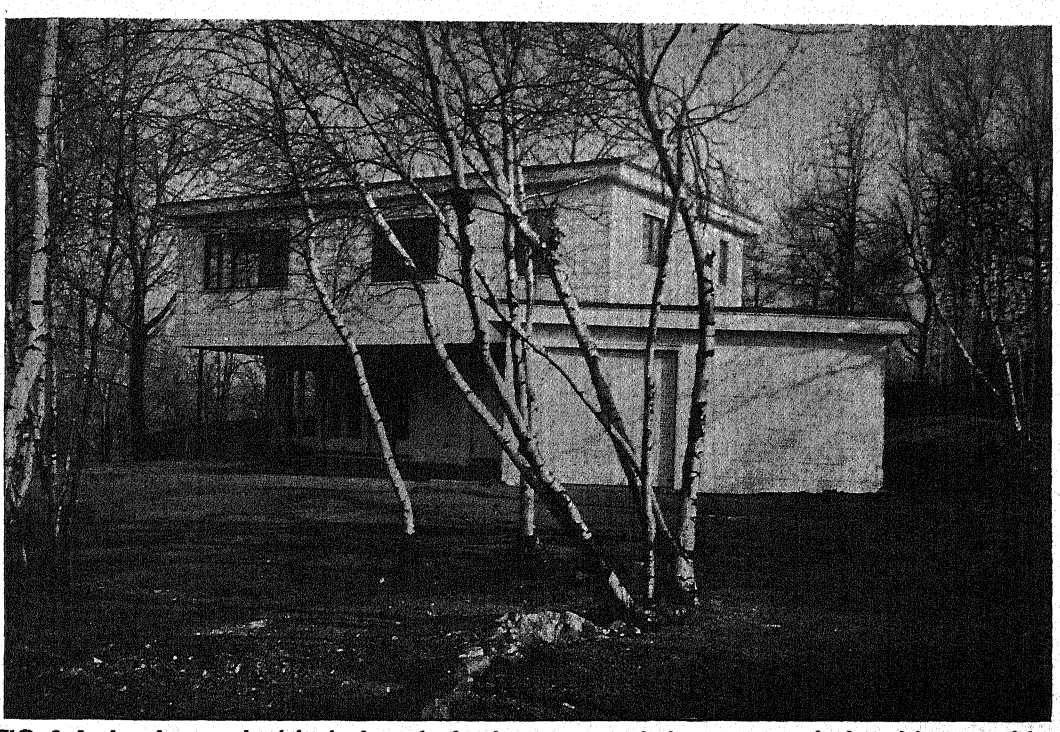


FIG. 2. In this photograph while the bare sky has been minimized, the interesting shadowed foreground has been given greater prominence. The new house, designed by the New York architect John R. Weber, is surrounded with birch trees on all sides, and was photographed in early spring, without obstructing foliage
Photo, Barbara Morgan

our distance, we will employ not less than a 14- to 18-inch element to cover an 8 x 10 plate or 10- to 12-inch for a 5 x 7. This getting the image of the house in the size we want it by working from a vantage point at some distance and, as it were, pulling the house up to us with a longer focal length, serves both the ends of true perspective and pictorial quality.

Details. It should be remarked here that the tendence in home photography is definitely in the direction of intimate details or close-ups, rather than the comprehensive views we have just discussed (Fig. 4). An entrance detail or section of a front, for example, gives us at a glance appreciation of style of architecture, materials used, charm of sculptured stone, carved wood, details of paneled doors (Fig. 5), and kinds of windows —to mention only a few items.

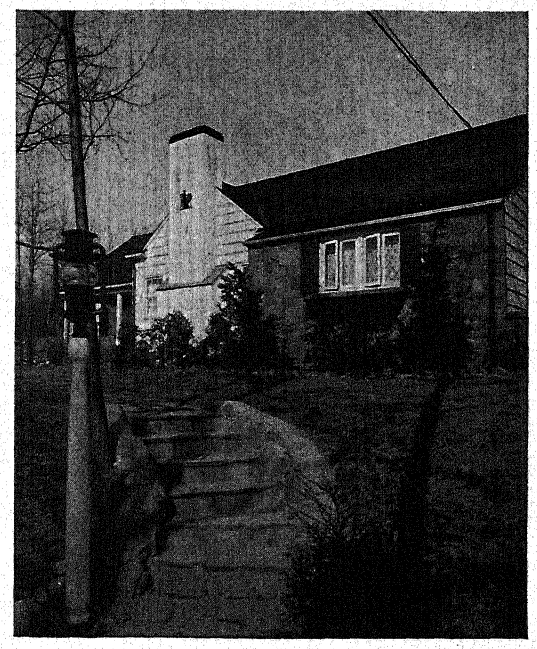


FIG. 3. The curved steps in the foreground help to lead the eye into this picture. The problems of wires and a distracting view to the left were well solved
Photo, John Levick

FILMS AND FILTERS

A word about films and filters. They go together. The architectural photographer



FIG. 4. The intimate detail is important in house and home photography and here is a window decoration which has been brought out
Photo, John Levick

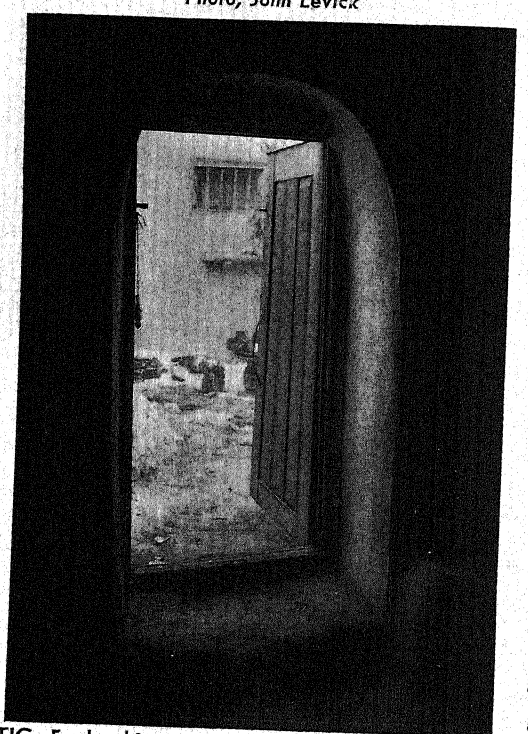


FIG. 5. Looking out into the patio of a house at Ranchos de Taos, New Mexico. No light was needed inside, as the adobe construction and wooden door were effectively portrayed by natural light
Photo, Theodore Fisher

who wants his pictures to represent a natural rendering with translation or transposition of nature's gamut of colors into full scale monotone, will use a panchromatic film and a filter. I have found a K2 filter just right for correct sky and cloud values (Fig. 6). If a more dramatic contrast with darkened sky is wanted (and clients do occasionally like them) then a deep orange or red filter can be used. But let me suggest the latter for what we might term a post-graduate course.

There is no *one* best film for architectural photographs. I can from experience, however, name a few that are most satisfactory:

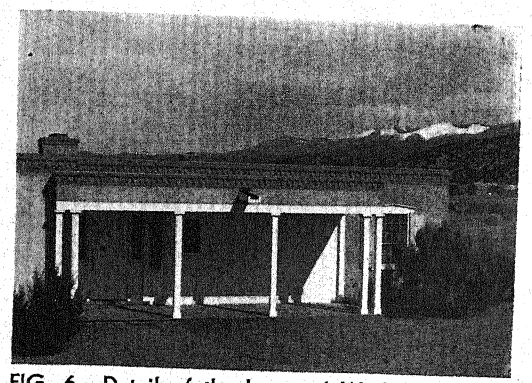


FIG. 6. Detail of the home of W. Lester Hyde, architect, at Santa Fe. This was taken from the top of a car, so that the distant mountain view could be included
Photo, Theodore Fisher

Agfa Isopan, Superpan Portrait, Defender XF (extra fast) Panchromatic, Eastman Panatomic X, Super Sensitive Panchromatic, and Tri X. One of the architectural photographer's chief technical problems is to secure negatives with shadow detail and not blocked up in the highlights. Choose a film which will do this for you.

INTERIORS

The prime considerations for architectural interiors are: angle of view, lighting, arrangement of furniture, height of lens, and exposure time. The first connects with the right focal length to be used. Although the opening comment on focal lengths still holds good within doors, working as we now generally are in close quarters, we are compelled to use the wide-angle objectives mentioned. For general views, those showing an end wall and the two side walls, a position that favors



FIG. 7. Myers residence, Santa Fe; Reginal D. Johnson, architect. As described in the text, this interior—though appearing to be lit solely by natural light—was illuminated with a combination of sunlight and photoflood
Photo, Theodore Fisher

the side walls about equally or one such as Figure 7 with the fireplace side given more prominence, is excellent. About a 56-inch height of the tripod top is an experimental level. We will get our relative floor and ceiling areas in the negative partly by this adjustment of height and partly by use of the rising and falling front. The psychological element comes in again at this point in that we are more conscious of the floor than the ceiling when in a room.

Pictorially, details of interiors rather than general views are usually the most pleasing. What we might call the vista idea—the eye led on from one area or room

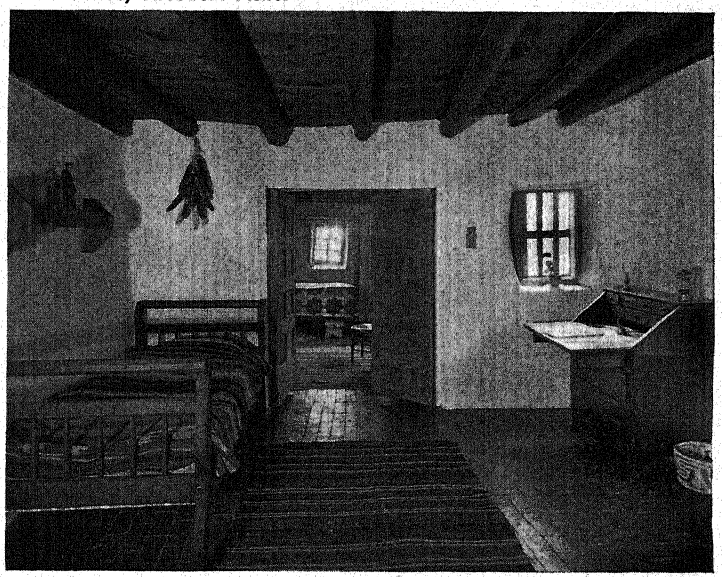


FIG. 8. Windows are often a problem and balancing indoor artificial light made it possible—in this view of the Hamilton residence at Santa Fe—to point the camera into the windows without blocking them by over-exposure
Photo, Theodore Fisher

to a delightful prospect beyond—is illustrated in Figure 8. The outside view looking through a doorway can, more rarely, be used.

Lighting. With the development of the high power tungsten floodlights, now a commonplace both in portraiture and architectural interiors, the most difficult aspect of technic can be controlled. Even where sunlight can be used to supplement floodlights, many photographers now use only artificial lights. My own preference is a combination of the two sources, aiming at the *appearance* of sunlight only. With the minimum possible exposure, correct development of the negative, and a maximum volume of tungsten light, one can even point into windows and not block them up (Fig. 8).

While there is much available in the way of lighting equipment, my own choice is the Victor deep bowl reflector either for use on a stand, held in the hand or fastened to the back of a chair. With such a lamp I can throw a beam into distant corners as well as illuminate nearer objects. One warning at this point. With so much light available, the beginner must be careful not to obliterate a balance of light and shade, with everything in a garish high key. In Figure 7 a 1500-watt light was used briefly on the left foreground and to bring out ceiling beams. The far corners should, as here, show less detail than objects nearer the eye.

Furniture. Arrangement of the furniture will be a continuing problem—I find it takes the most time on the job. Ninety-nine chances to one the photographer cannot take the furniture arrangement as he finds it. The convenience of the dwellers in a home and the canons of interior decoration have little to do with the case. True perspective is impossible for objects very close to the camera, so we have to rearrange them. At further distance the problem connects with the cutting of one object against another. The net result usually is that chairs have to be rearranged and several removed from the scene. The photographer can go too far in this business of rearranging furniture, etc. The purpose of the photograph is to show not only a house interior, but a *home*. House and home interior photography can differ from other more formal types of interior photography (see article on *Interiors*).

HUMOR IN PHOTOGRAPHY

Arthur Rothstein

Farm Security Administration Photographer

Photographers are often apt to take their hobby or profession too seriously—never realizing that the photograph can be a forceful vehicle of humor. A well-known photographer here tells of the peculiar problems involved when using a literal medium like photography for humorous purposes.

See Also Tricks in Photography

FIRST OF ALL, before we discuss how to appreciate and make humorous photographs, you must have a sense of humor. All psychologists agree that to enjoy humor or even to recognize it you must be in the proper frame of mind. It seems, also, that what is humorous to one person is not necessarily funny to another. These conditions are especially pertinent when you use an essentially realistic medium like photography which rarely is capable of the imaginative fantasy of prose or the cartoon.

Just the same, some photographs make us smile, chuckle, or laugh, although there are altogether too few of them. If we can figure out why we laugh at funny pictures, it will help us to determine what kind of photograph will make us laugh.

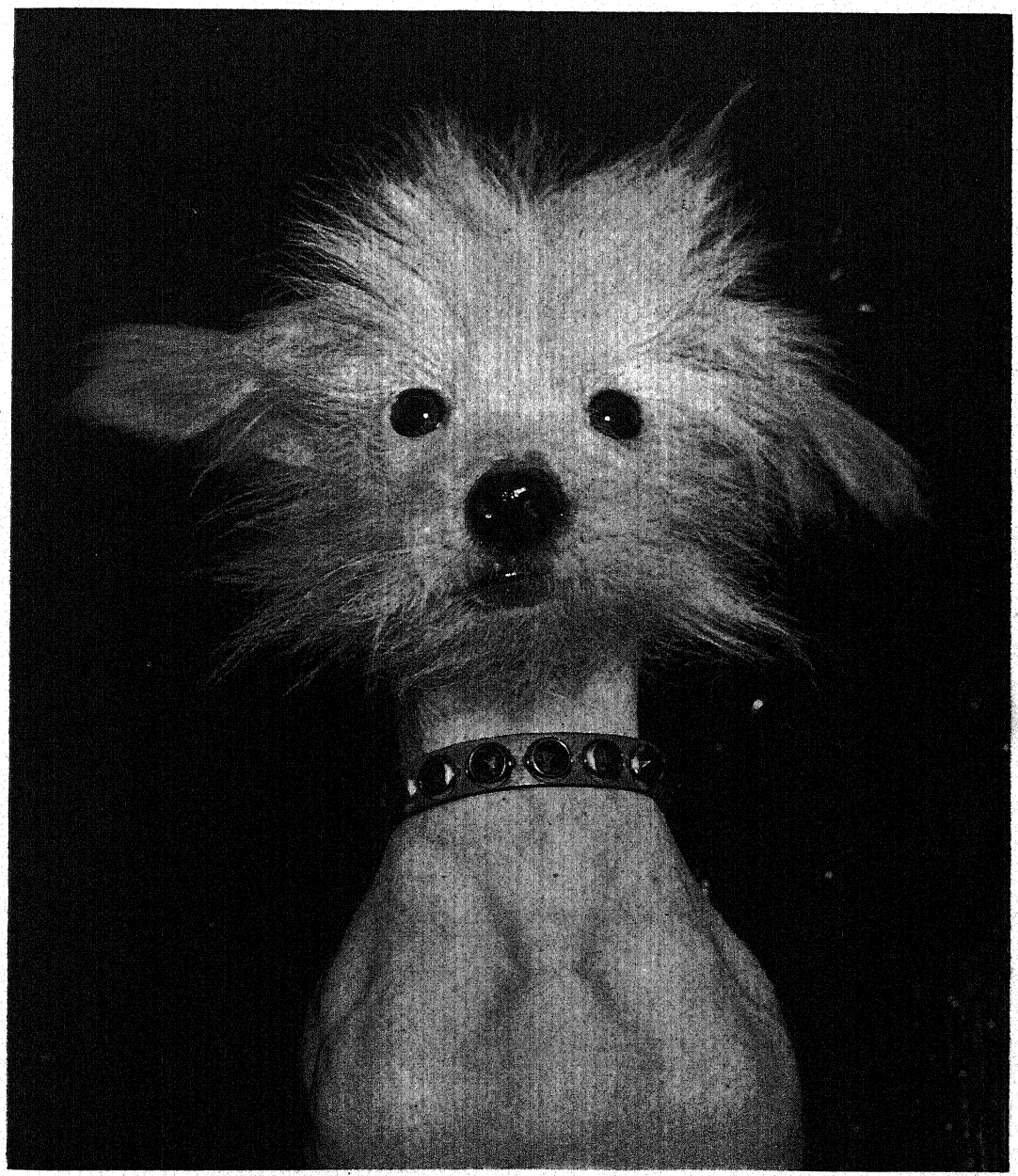
ESSENCE OF HUMOR

Plato said that "the pleasure of the ludicrous originates in the sight of another's misfortune." According to Thomas Hobbes, "the passion of laughter is nothing else but the sudden glory arising from a sudden conception of some eminency in ourselves by comparison with the inferiority of others." James Thurber, however, discusses the subject with a little more thought. "Humor is the best that lies closest to the familiar, to that part of the familiar which is humiliating, distressing, even tragic. Humor is a kind of emotional chaos told about quietly and calmly in retrospect. There is always a laugh in the utterly familiar. People can laugh out of a kind of mellowed self-pity as well as out of superiority."

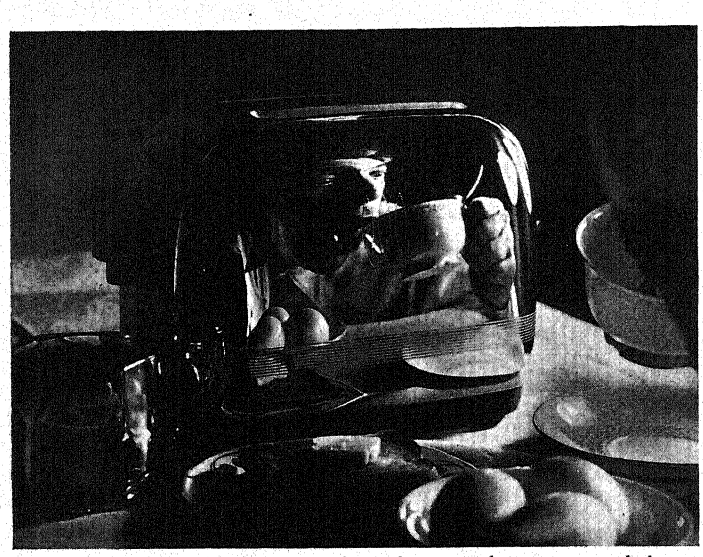
As our last authority, Art Young says, "why we laugh is generally because we have seen or heard something that is at variance with custom. Customarily, a man stands upright on his two feet. If he falls down it is

considered funny. I see no reason why we should be amused at his fall, except on the theory that he is supposed to keep his balance like everybody else."

All this means that we laugh at pictures that present to us a state of affairs that is enjoyably incongruous. But not all humorous photographs are funny to all observers. This is because it is first necessary to be in a playful or receptive mood in order to appreciate a comical pictorial situation. Secondly, the situation must be enjoyable. We should be agitated enough to be tickled, but not enough to feel pain. When we see such a



WHO'S SCARED? Photo of a Mexican Hairless, exhibited in the Seventh Annual New York Press Photographer's Exhibit
Photo, Tom Sande



BREAKFAST WITH MYSELF. A clever distortion shot, using simple home articles
Photo, Walter E. Thwing

photograph we should realize that there is something wrong about it, but this wrongness must not be severe enough to produce an emotion that will keep us from enjoying it. We can't have a good hearty laugh if we're angry or afraid or too concerned. There must be incongruity, just enough deviation from things as they ought to be—*but not too much.*

Furthermore, a picture that is humorous must bear a resemblance to something that is completely sensible. It may be an utterly artificial resemblance, but it



GOLDILOCKS AND THE HOT DOG. Taken by a *New York Daily Mirror* photographer, during a heat wave. Hung at the Seventh Annual Exhibit, New York Press Photographers Association
Photo, William Stahl

must be there. Also this similarity should be new and unexpected. The sudden perception of the ridiculous, artificial, and incongruous resemblance creates humor sensed immediately by most of us.



CORNFIELD RENDEZVOUS. Example of the staged humor photo. DATA: 4 x 5 Speed Graphic, fast pan film, two flashbulbs on dark day
Photo, Lou Gardner

THE PHOTO MEDIUM

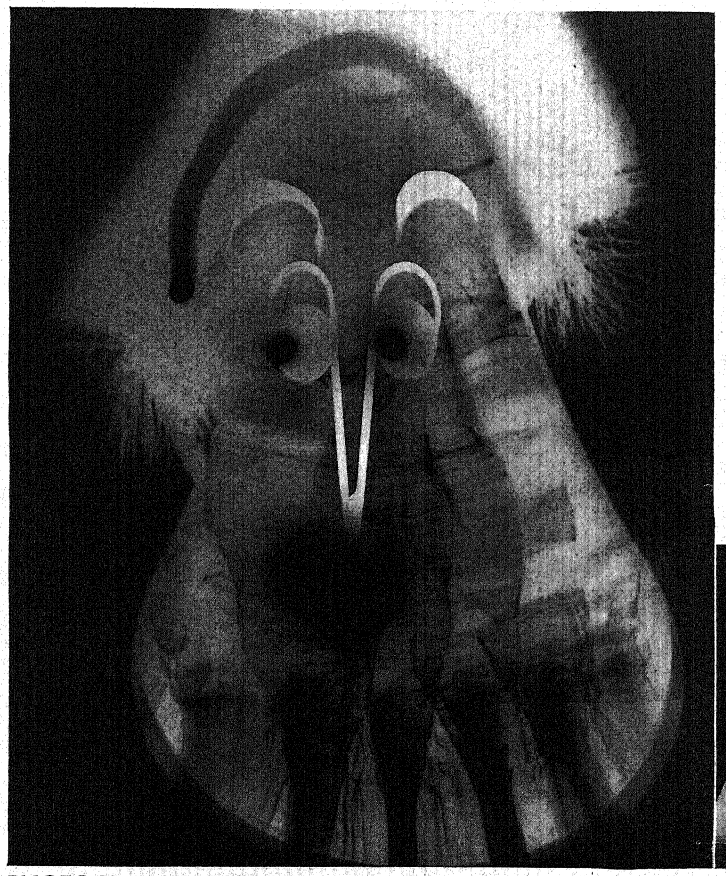
In photography, the number of ways of presenting amusing incongruities are limited somewhat by the nature of the medium. At its best, a humorous photograph should be comic by its own intrinsic nature. The laugh must not be in the caption. There may be a witty caption, but its wit should be enriched by the picture.

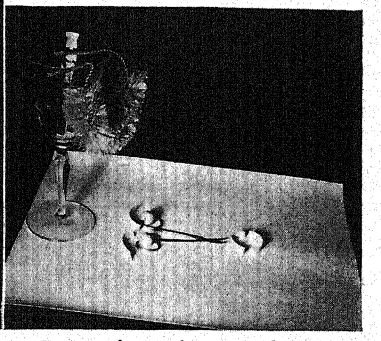
It is more difficult to achieve this ideal in photography than in any other graphic art. A cartoonist may use imaginative characters in an imaginative situation to produce a highly incongruous and consequently humorous picture. A photographer, even when he resorts to technical tricks, is nevertheless forced by the nature of the camera to deal with real objects and real people under comparatively plausible conditions.

HUMOROUS SUBJECTS

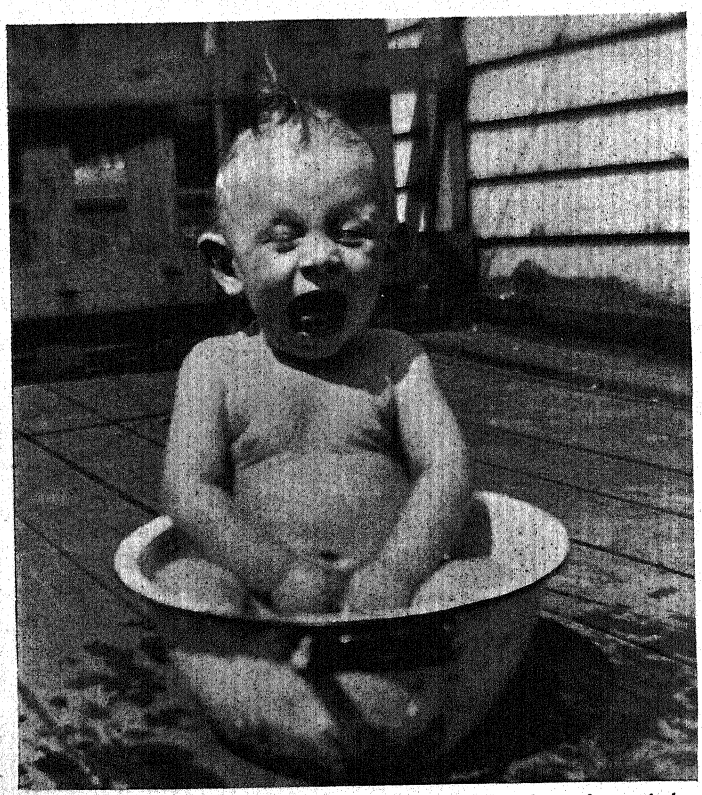
Considering all the foregoing, we find that the types of photographs that make us laugh will fall into four groups.

Pictures that deviate from the truth can be funny. When a photograph contains a fantastic resemblance to the truth, if we can see what the truth is and detect





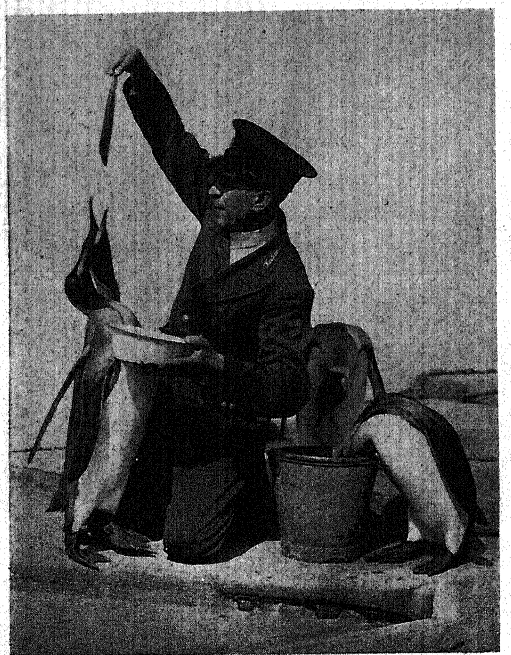
PHOTOGRAM CARICATURE. Personal friends and national figures may serve as subjects for your photogram caricatures. The one at the left was made from a set-up of brushes, scissors, etc., by exposing the sensitized paper with a single light casting shadows from the left
Photo, Rene W. P. Leonhardt



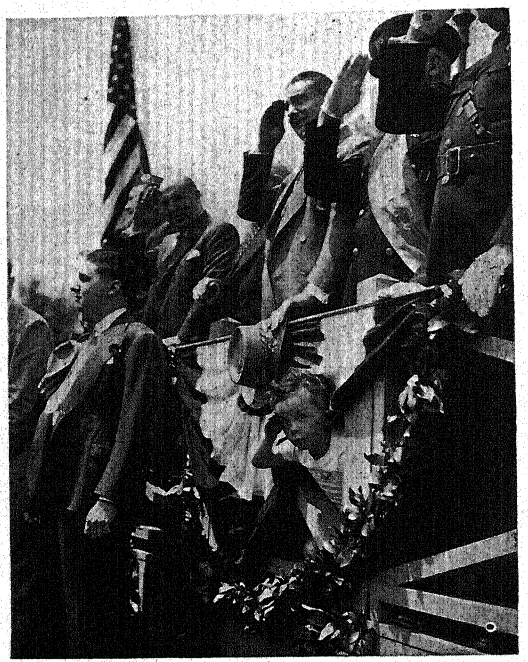
BATHING BEAUTY. An amateur photograph, taken by a doting father
Photo, Raymond Schaefer

the untruth, there is humor in the false statement. If a picture presents a distorted view and we know the real situation, we recognize and enjoy whatever is at variance. Thus we laugh at an exaggeration, a caricature, or pictorial sarcasm.

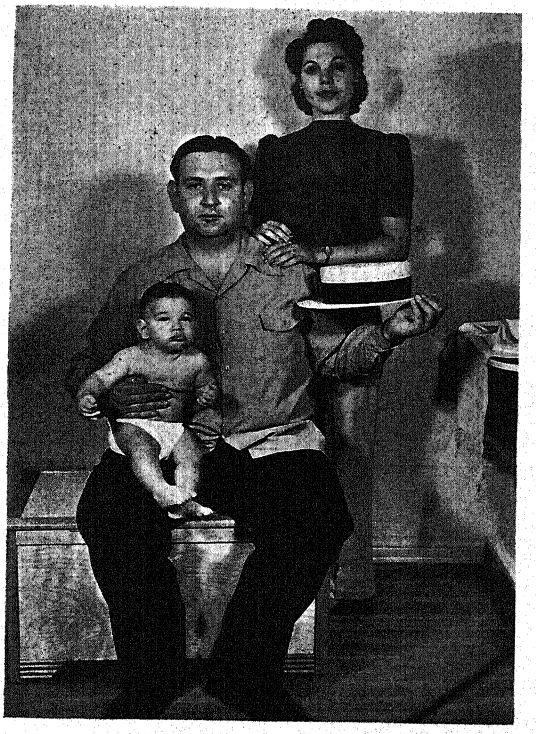
Photographic practical jokes can be comical. The humor of the practical joke lies in seeing or imagining the bewilderment, embarrassment, or discomfiture of the person upon whom the joke is played. The incongruity that makes the humor is between the facts as the joker knows them to be and the situation that the victim supposes to be the fact. Thus we laugh not only at photographs of practical jokes, but also at the comparison of two pictures which are in themselves not funny. For example, a hind



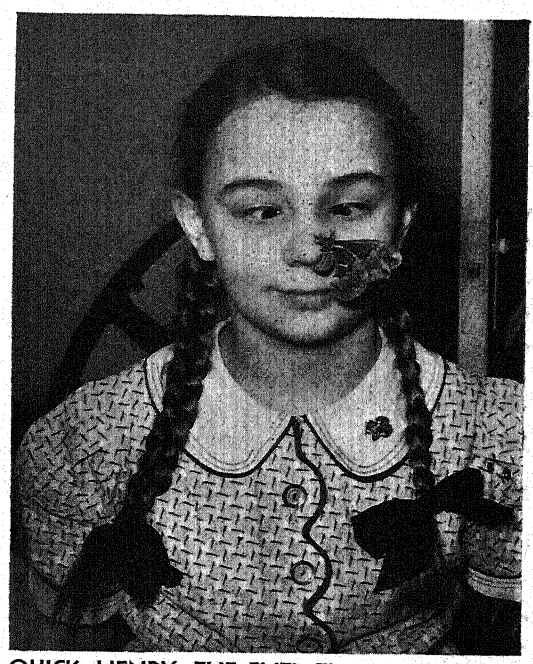
FEEDING TIME. Taken at the London Zoo
Photo, H. Guttmann



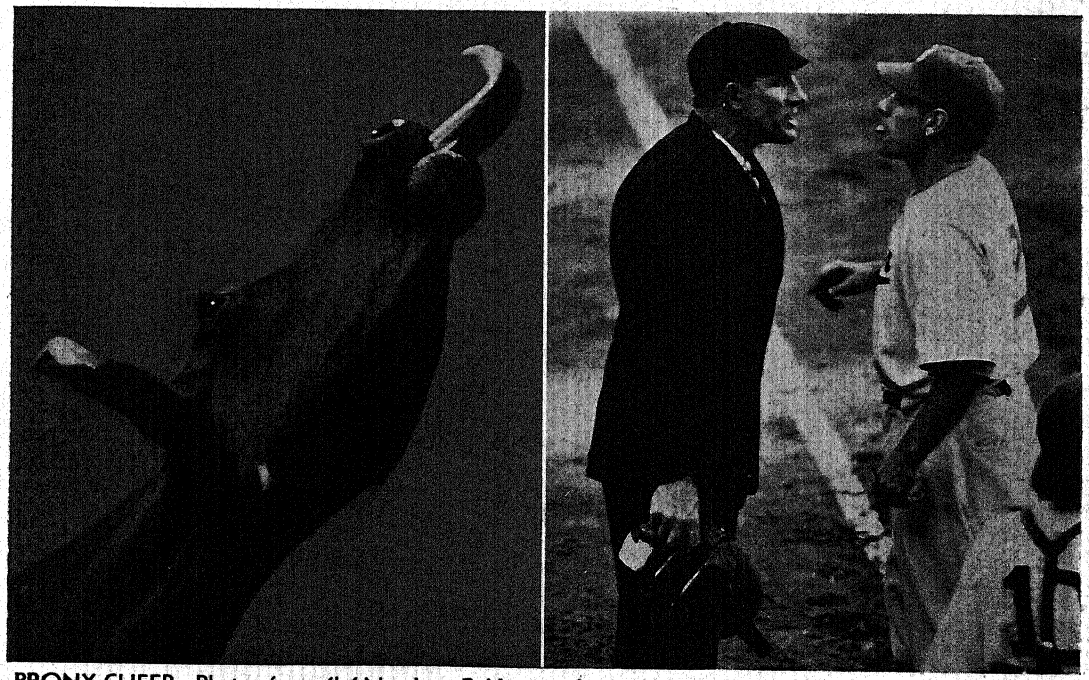
GRAND STAND. Taken by a *New York Daily News* photographer
Photo, Ossie Leviness



FAMILY PORTRAIT. A prize winner in the Humor Section of the Graflex Golden Anniversary Photo Contest
Photo, Julius Shulman



QUICK, HENRY, THE FLIT! This gag photograph was taken while on a feature assignment for the *Milwaukee Journal* and it shows a girl scout and her pet butterfly. The picture was also a prize winner in the humor section of a recent Graflex Photo Contest. DATA: 4 x 5 Speed Graphic, fast panchromatic press film, 1/200 second, f/22, Press-40 flashbulb
Photo, Robert Boyd



BRONX CHEER. Photo of cow (left) by Jane F. Hoops; photo of Manager Durocher of the Brooklyn Dodgers (right) by International News



CHIVALRY. At a Denver Art Students Ball, this model won first prize. The Air Corps major is more flustered than he looks, since his left arm is protecting the model from overexposure—after one of her "hands" fell off
Photo, Pat Coffey

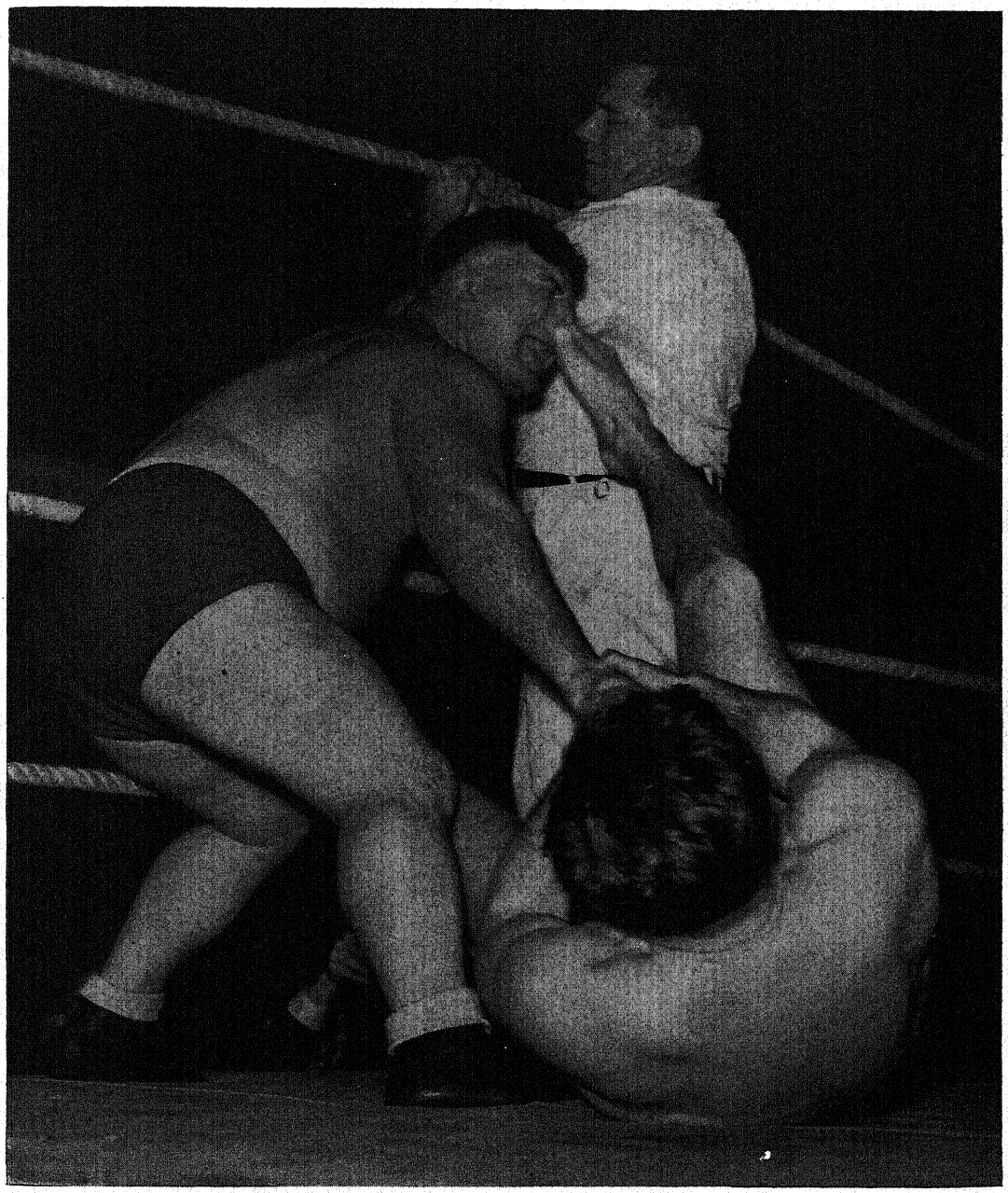
view of a zebra placed next to a back view of a woman in a striped bathing suit has been very comical to some people (see article on *Juxtapositions*).

When a photograph shatters our expectations—perhaps by showing the impossible happening—it can make us laugh. We see an over-all normal situation which includes something which is deceiving and differs from the facts. Our sudden surprised recognition of this incongruity is humorous. A photograph that upsets our conception of things as they are or should be has comical possibilities.

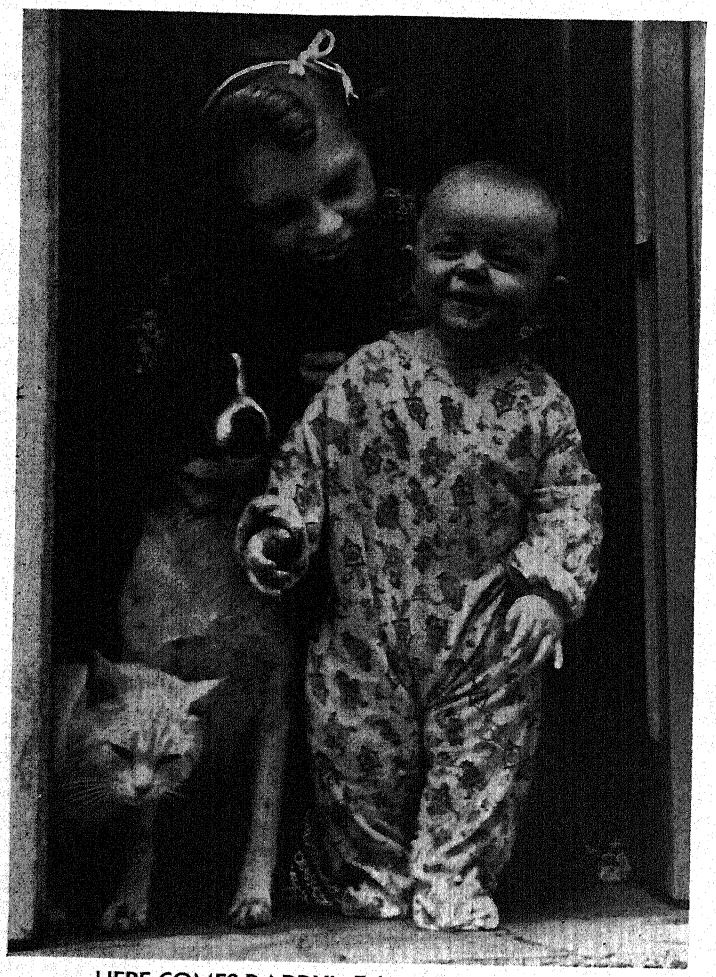
Finally, there are photographs that make us laugh sympathetically. We identify ourselves with the subject or perhaps have had experiences similar to those pictured. In its simplest form this type of humorous photograph might be a picture of a person or group enjoying a good laugh. In its more highly developed form, this type of picture employs the technic used so effectively by Charlie Chaplin. The photograph may show an ordinary man doing something very simple and familiar, but something goes wrong—with humorous consequences. If we have undergone a similar experience at some time, our identification with the picture makes us laugh.

These various kinds of humorous photographs are made in several ways. Most frequently a photographer, quite seriously, takes a picture of a serious event. In retrospect, however, the situation contains laugh-provoking qualities. This type of humorous photograph will always be present as long as unpredictable things happen when we click the shutter. Also, there are photographers with a sense of humor who see things that they realize are comical and proceed to record the funny situation on film so that others may laugh too. Sometimes, a photographer deliberately decides to make a picture that will make us laugh. Unfortunately, these are rare. Perhaps it is because photography is such a comparatively new and unexploited medium of expression. We should feel that a photograph which makes us say "How funny!" is just as significant an effort as one that makes us say "How sad!" or "How beautiful!" And they are often more difficult to take.

Suppose then, that you want to take humorous photographs. We assume that you have a sense of humor and are in a playful mood. You are also aware of the types of photographs that make people laugh. You can either wait for something funny to happen or you can plan or build up a funny situation. If you are on the lookout for humorous situations to photograph, be sure to recognize them at once and shoot the picture quickly. Often, pictures like these owe their success to the quick response of the photographer and his ability to capture people's expressions at the most comical



TOE HOLD. Taken for *The Milwaukee Journal*
Photo, Robert Boyd



HERE COMES DADDY! Taken for *Look Magazine*
Photo, Earl Theisen

part of the action. You should have a fast shutter and synchronized photoflashes will be helpful.

If you want to set out deliberately to make a humorous photograph, strive for an incongruity of some sort. Plan a situation that is absurd. For example, you can make caricatures of your friends by distorting their features with a wide-angle lens. You can make a photomontage or place two pictures side by side, creating a comical comparison. Various tricks such as the use of double exposure, double printing, negative reduction, paper negatives, and dodging during enlargement may be used to produce amusing pictures of impossible situations. Professional joke makers know that there are certain subjects and situations which are inherently funny to the average person. You can make photographic jokes too, about the old maid, the effects of alcohol, the talkative lady, whiskers, the boarding house, and married life.

Remember, then, that photographic humor must not be forced. And also bear in mind that *everyone* is not going to laugh at your prize funny photograph.

The camera is capable of expressing great beauty or of conveying potent reality. But there is nothing degrading about applying the camera in the field of humor. Many photographers — and amateurs are meant here more than professionals, of course — work too hard at photography. In the end they lose sight of one prime purpose of the camera—to get and give pleasure. In the last analysis, the fun you have with your camera and the humorous quality of your photographs will depend on your imagination and your sense of humor.

HYPERSENSITIZING FILM

Lloyd E. Varden
Product Information and Camera Club Departments, Agfa Ansco; Editor, Agfa Diamond

There are three ways to hypersensitize or increase the emulsion speed of a film: by a liquid forebath, by treatment in dry vapors, and by pre-exposure. These are described in detail for the advanced photographic worker who wants to add to the sensitivity of his working materials.

See Also Desensitizing

THE PROCEDURE of hypersensitization consists of treating a photographic emulsion either before or after exposure so that the amount of exposure required to give a useful developed negative image is less than if the treatment were not given. Various methods for hypersensitizing have been proposed and published but only one or two methods are

worthwhile and practical. Generally, the methods can be placed in one of the following categories:

1. Treatment of the film *previous to exposure* in various liquid baths.
2. Pre-exposure of film to a diffuse uniform light source.
3. Treatment of the film in dry vapors.

USE OF FOREBATHS

Schumann, as early as 1885, showed that a preliminary bathing of an emulsion in a weak solution of ammonia improved subsequent sensitization by certain dyes. Later it was found that bathing in ammonia solutions increased the sensitivity of already color sensitized emulsions. This earlier work characterizes the action of alkaline solutions for hypersensitizing even present-day emulsions. Such methods lead to increased speed accompanied by, but not necessarily due to, a gain in color sensitivity. In other words, the inherent (natural blue) sensitivity remains practically constant while the conferred sensitivity (by dyes) is increased.

The following formula has been reliably recommended as a hypersensitizing forebath:

Stock solution:

80 grams sodium carbonate (crystals)
80 cc ammonia (specific gravity 0.880)
1000 cc distilled water

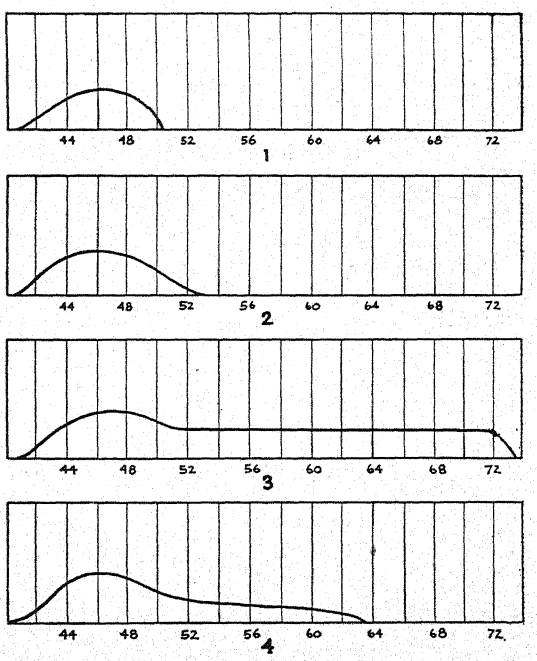
For use, dilute 1 volume of the stock solution with 20 to 40 volumes of distilled water. The temperature should be held low, preferably around 12° C (about 54° F.).

Films should be bathed for 5 minutes in the freshly diluted solution and without rinsing should be treated for 5 minutes in methyl alcohol. Drying should be accomplished rapidly, using an electric hair dryer or similar device. Rapid drying is important.*

Other alkaline solutions have been proposed: e.g., triethanolamine, 1:1000 solution with distilled water, bathing emulsions from 2 to 3 minutes. Drying again should be rapid and begun immediately without rinsing.

It seems strange, however, that in spite of the many special solutions which have been tested, plain rinsing in a stream of tap water should accomplish almost as much. But, strange as it may seem, a 5-minute rinse in tap water not higher than 15° C (59° F.) followed by 1-minute and 3-minute successive treatments in methyl alcohol to assure rapid drying, will increase emulsion sensitivity in many cases 50% or more, which is about all that can be expected from use of other solutions.

J. G. Capstaff found that ordinary blue-sensitive emulsions, if washed for prolonged periods in faintly alkaline water immediately after a short treatment in a 2% solution of sodium bisulphite, gained considerable color sensitivity. Hard tap water is sufficiently alkaline for the purpose. This procedure should no doubt be included among the hypersensitization methods by means of forebaths.



The above tracings from published wedge spectrograms show how the Capstaff effect proceeds. Curve 1 shows the sensitivity after the film was held in running tap water for 5 to 15 minutes. Curve 2 shows slightly increased sensitivity after 1 to 5 hours of washing. Curve 3 shows a pronounced gain in panchromatic sensitization upon washing the film for 24 to 30 hours. To speed up the action, the wash water was made alkaline by sodium carbonate and, after only 5 or 10 minutes, the color sensitivity was increased greatly, as given by curve 4. It will be noted that the sensitivity gain through the spectrum in 3 represents a lateral shift without the characteristic peaks that are exhibited in dye sensitization

* Stressed by B. H. Carroll and D. Hubbard in their Bureau of Standards Research Paper, No. 525, on the mechanism of hypersensitization.

HYPERSENSITIZING BY PRE-EXPOSURE

An age-old method for increasing film speed is by the so-called "pre-fogging" method. Actually, this is not a good name for the process since the amount of pre-exposure should not be sufficient to cause considerable fog. The method is based upon the fact that silver halide crystals require a certain amount of light before the film can begin to show density. In other words, there is a certain inertia which must be overcome before an emulsion will begin to respond to light. Unfortunately, the pre-exposure method of hypersensitizing has always been difficult to apply since the exact amount of light to give a film was not known nor had the optimum relations between light intensity and time of exposure been worked out to enable the effect to be of any value in a practical sense.

Rather recently, the DuPont Film Corporation has reexamined the hypersensitizing method based on uniform exposures to light and has found that if films are exposed to a weak light, such as the light given off by a deep green safelight (Wratten series 3 or Agfa Ansco A-3), the emulsion speed can be boosted by one to two stops, depending upon the nature of the film. They have applied the term latensification to the procedure, since the exposure is given to the film *after* the camera exposure is made—on the latent image. However, as in mercury hypersensitizing, the hypersensitizing treatment can be given to the film before or after camera exposure, although the effect is much more noticeable when given *after* the camera exposure. This means that the exposure acts as a true intensifier for the latent image and cannot be regarded in a strict sense as a hypersensitizing method. What the uniform exposure to weak light accomplishes is similar to what is accomplished in mercury hypersensitization. The sensitivity specks resting on the silver halide crystals, which grow in size during camera exposure, are increased in size in such a way that those crystals which did not receive enough exposure in the camera so that the growth of the sensitivity speck was sufficient to cause developability, will be raised to the necessary size level, permitting them to be developed.

Unfortunately, there is no simple procedure that can be followed for all types of films in carrying out the latensification process. However, as a rough guide, one can experiment with the process using 15 to 20 minutes exposure, with the film held emulsion facing the safelight at a distance of 15 feet.

DRY HYPERSENSITIZATION BY MERCURY VAPORS

When Dersch and Duerr of the Agfa Ansco Research Laboratories in 1937 announced the re-discovery of hypersensitization by mercury vapors, the wet methods immediately fell into disfavor. The mercury vapor procedure presented several distinct advantages.

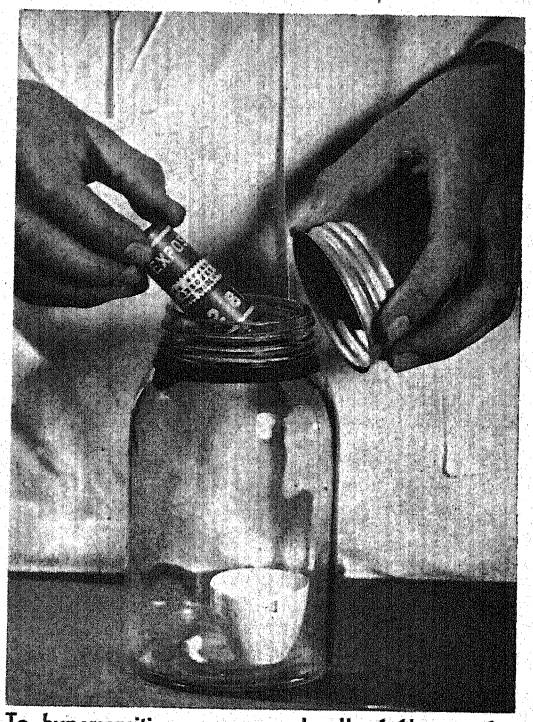


Print *a* was made from a negative that was intentionally underexposed. The negative was thin and lacking in shadow detail. Another exposure, the same as used for the negative from which print *a* was made, was hypersensitized in mercury vapor before development. In making the print the same exposure was used as for print *a*. It is clear, then, that the negative *b* had greater density and more shadow detail. Still another exposure was made, the same as in the above cases, but the negative was treated by mercury vapors before and after exposure *c*. In making the print, the exposure was held constant and, because of the higher negative density, the print is considerably lighter than in the above cases

1. The film to be hypersensitized could be treated before or after exposure, or both.
2. The film could be left in its paper wrapping during treatment, and motion picture films did not have to be unwound. However, for fastest action the bare film had to be exposed to the vapors.
3. The increase in speed was not accompanied by a change in either gradation or relative color sensitivity, whereas the forebath methods characteristically increased the relative red sensitivity.
4. Treatment by the mercury vapors did not destroy the normal sensitivity of the film even if the period between treatment and exposure was too long to realize effective speed gains. A second treatment or even a third or fourth could be given without harm.
5. The method was convenient since the mercury vapor could be derived from amalgams or small pools of mercury at room temperatures.
6. The gain in speed was not accompanied by an increase in fog or grain size.

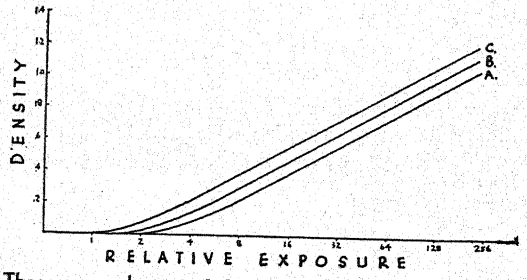
The Method In Practice. A light-tight box is provided if the film is to be treated unwrapped; but an air-tight container will suffice if treatment is given to wrapped materials. A few grams of mercury are poured into a small dish and placed in the container. The film is suspended or rested somewhere within the box out of contact with the mercury itself. (Actually, an amalgam is more convenient since a solid source of mercury vapors is to be preferred over the liquid mercury. Sodium amalgam can be prepared by placing a small slab of freshly cut sodium metal onto the surface of a clean pool of mercury. A reasonably violent reaction will take place which requires that the experimenter stand back away from the scene of events until the amalgam is produced.)

As a general rule, loose and unwrapped films should be exposed to the mercury vapors within the tightly closed container for a period of about 30 or 40 hours, while wrapped and spooled films require from 9 to 10 days.



To hypersensitize an exposed roll of film, a glass vessel such as a quart fruit jar can be used. The roll of film is placed in the jar adjacent to a small crucible containing a few grams of mercury. The jar is then capped and not opened until the required time for completing the hypersensitization

A gain of from 50 to 100% in speed can be expected with many types of films if hypersensitized either before or after the camera exposure. If treatment in the mercury vapors is given both before and after exposure in the camera, a gain of from 100 to 150% is likely. It should be stressed that the general standard of film sensitivity has



These are characteristic curves of a commercially available emulsion showing the increase of sensitivity upon mercury vapor treatment. Curve *A* is for the untreated film. Curve *B* is for the film treated in mercury vapor before exposure. Curve *C* is for the film treated in mercury vapor after exposure. An even greater gain in speed can be effected by mercury vapor hypersensitization both before and after exposure of the film

been advanced considerably since 1937, when the dry hypersensitization procedure was disclosed. Therefore, many present-day films show little improvement in sensitivity after treatment. However, today, the need for increasing film speed is not so great as it was a few years ago.

REACTIONS OF FILMS

Almost any film can be hypersensitized, but obviously some films perform better than others. The exact nature of the performance of a given film depends considerably upon the method of hypersensitizing. In general, however, it can be said that the slow and medium speed films respond better than high speed films to all types of hypersensitizing. Moreover, dye-sensitized films usually gain more speed than films which have not been dye sensitized.

It is frequently thought that very high speed films cannot be made any faster by hypersensitization. Nevertheless, it has been shown rather recently that even the highest speed films can be made still more sensitive if the method of treatment is suitable for the particular emulsion in question. For example, three high speed films—namely Superpan Press, Superpan Supreme, and Ultra-Speed Pan—were treated in mercury vapor for 24, 48, and 72 hours. The table given below shows how much sensitivity was gained by these films.

24 Hours

	Speed	Gradation	NET FOG Treated	Untreated
Superpan Press	+ ½ stop	Slightly Flatter	.10	.06
Superpan Supreme	+ ¾ stop	Slightly Flatter	.09	.06
Ultra-Speed Pan	+ ½ stop	Slightly Flatter	.09	.06

48 Hours

Superpan Press	+1 stop	Flatter	.20	.06
Superpan Supreme	+1½ stop	Flatter	.19	.06
Ultra-Speed Pan	+1 stop	Flatter	.19	.06

72 Hours

Superpan Press	+1½ stop	Flatter	.23	.06
Superpan Supreme	+1 stop	Flatter	.18	.06
Ultra-Speed Pan	+1 stop	Flatter	.19	.06

In view of the high fog associated with treatments longer than 24 hours, it is inadvisable to allow any of the above films to remain in the mercury vapor for longer than this period.

The Effect of Hypersensitizing on Grain and Contrast. Almost invariably films which have been hypersensitized will exhibit increased graininess and a lower contrast than the film would ordinarily show with normal use. The increase in graininess is usually in proportion to the amount of speed gained. The graininess of a hypersensitized film is about the same as a film which has inherently the same speed as the hypersensitized one. The notable exception to this is dry hypersensitization by mercury vapor.

HYPO ELIMINATION

Walter Clark, Ph.D., F.R.P.S.
Kodak Research Laboratories

Fading and yellow image stain in prints or film are often apt to result if hypo is not thoroughly washed away. The factors involved in efficient hypo elimination are told here—along with formulas for hypo eliminators and tests for detecting the presence of hypo.

See Also Defects in Negatives and Prints, Fading of Prints, Fixing

DEVELOPED NEGATIVES and prints are washed after fixation in order to remove as much of the hypo as possible. This is important because *if hypo is allowed to remain it may cause fading of the image.* This fading is familiar to most photographers who possess old negatives or prints in the yellowing of the photographs, staining of the unexposed areas, and perhaps bleaching of the highlights. This change occurs particularly if the storage has been under conditions of high temperature and humidity.

CAUSES OF FADING AND STAIN

The yellow color is due to the conversion of part of the silver image to silver sulfide, which is normally yellow or brownish in hue. Staining of the parts of the photograph which contain no silver image is also due to silver sulfide, which is derived from combinations of silver salts and hypo having their origin in an exhausted fixing bath or in incomplete fixation. There are other factors which may cause yellowing of the photograph—for instance, traces of hydrogen sulfide gas—but these are external causes and are not necessarily affected by proper elimination of hypo from the photograph itself.

There are several factors which determine the rate at which a negative or print will

fade. Within limits the rate of fading is roughly proportional to the amount of hypo present, and this may be very small indeed. For instance, in the case of papers, under certain conditions a concentration as low as 0.005 milligrams per square inch may cause fading. *The higher the humidity and temperature, the faster will fading occur*, and it will also be accelerated by traces of some salts and acids in the air. The size of the grains in a negative or print plays a very important part in determining the rate of fading. The finer the grain, the more rapid is the fading in the presence of traces of hypo. Under comparable conditions, a lantern slide will fade more rapidly than a negative on a fast film or plate. In the case of papers, prints on the chloride variety are more susceptible than those on bromide papers.

The tendency to fade from internal causes will be eliminated if all traces of hypo are removed. In some cases this is not as simple a matter as it may seem. Hypo will dissolve in water and it might appear that it could be completely removed by adequate washing. Although this may be so in the case of films and plates, it is not so with papers. Photographic paper consists of a tangled mat of cellulose fibers containing sizing and other materials and usually coated on its surface with a layer of baryta in gelatin. There is a strong tendency for hypo to be retained by the paper fibers and the baryta coating and *it is practically impossible to remove the last traces by simple washing.* Most photographers like their prints to be stable and, in the case of those used for record and archival purposes, it is especially important that they should be so. The same applies also to negatives and to positive transparencies on glass or film. Many attempts have been made, therefore, to devise means for insuring complete removal of hypo either by increasing the rate at which it is removed by normal washing, or by converting it into something which will not under any circumstances cause the image to fade. Materials for this purpose are known as "hypo eliminators."

Hypo eliminators, some of which are given on page 2071, either speed up the washing process or turn hypo into a chemical harmless to the image. The most valuable study of this subject was made in 1940 by Crabtree, Eaton, and Muehler.*

WASHING IN WATER

In the case of simple washing in water, the rate at which the hypo is removed naturally depends on the rate at which fresh water is renewed at the surface of the photograph. The hypo comes out of the negative or print by diffusing to the surface where it is washed away by the water. The ideal washing conditions are clearly those in which the water removes the hypo from the surface faster than the hypo diffuses out. Under ideal washing conditions, the two important factors which affect the rate of washing of both negatives and prints are the temperature of the wash water and the composition of the fixing bath. Figure 1 shows the effect of the temperature of the wash water on the rate of removal of hypo from a fast negative film (Verichrome). It will be noticed that as the temperature of the wash water increases, the rate of removal of hypo increases markedly.

* Crabtree, J. I., Eaton, G. T., and Muehler, L. E. "The Elimination of Hypo from Photographic Images." *J. Photog. Soc. America*, Oct., 1940, *6*, 6-13, et seq. This article contains a survey of most of the known hypo eliminators in addition to a report on the research leading to the above recommendations.

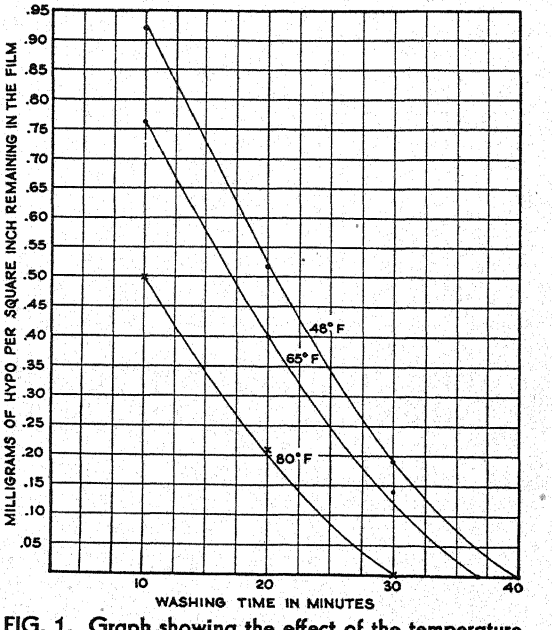


FIG. 1. Graph showing the effect of the temperature of wash water on rate of elimination of hypo from Verichrome film

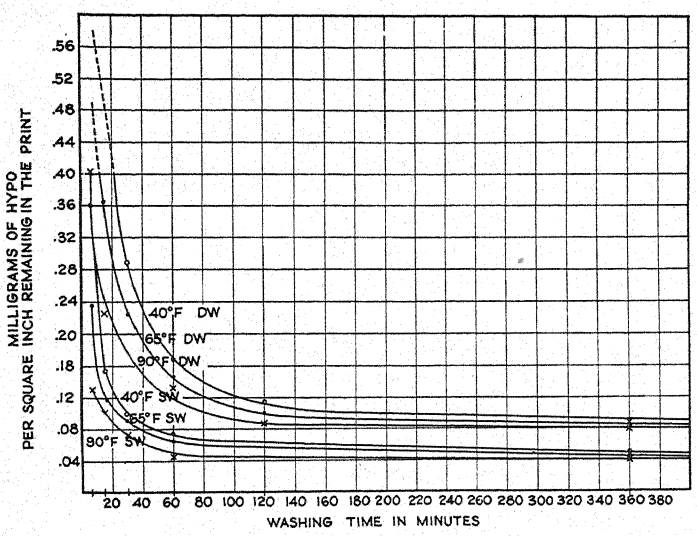


FIG. 2. Graphs showing the effect of temperature of wash water on the rate of elimination of hypo from prints on single and double weight paper

There is, however, a limit to the temperature which should be used in practice, for at the higher values there is danger of swelling and softening. It is found that under fixed conditions of temperature and water renewal, hypo is more readily washed from film fixed in a non-hardening fixing bath than from film fixed in a potassium alum fixing bath. If a chrome alum fixing bath is used, the washing time is somewhat less than for the potassium alum bath.

Figure 2 shows the effect of the temperature of the wash water on the rate of elimination of hypo from prints on single and double weight paper. The effect of temperature is very marked in the early stages of washing. In all cases, however, most of the hypo that will come out does so in about two hours, after which prolonging the washing for twenty hours does not remove the last traces. The amount left is sufficient to cause fading in some storage conditions.

OXIDIZING AGENTS

Many treatments have been proposed for shortening the washing times or converting the hypo to a harmless material. Most of the methods, however, have not worked adequately and in some cases resulted in some bleaching of the silver image. Most of the materials proposed in the past were compounds which the chemist knows as oxidizing agents. From the exhaustive work of Crabtree, Eaton, and Muehler, it is now known that two types of hypo eliminators are especially effective. They are alkalies and alkaline solutions of oxidizing agents such as hydrogen peroxide-ammonia.

Judged from the point of view of effectiveness and lack of detrimental action, ammonia is the most important alkali. Used in the wash water, it will markedly shorten the time for complete elimination of hypo from films and plates and will effect complete removal in the case of papers, provided an adequate time of washing is used. This time, however, is rather too long for practical washing of prints and the use of ammonia is preferably confined to the washing of negative materials.

Films and plates can be adequately washed by water alone, provided there is adequate renewal of the wash water and sufficient time is given. If an ammonia bath is used, however, the process may be speeded up. After washing for ten minutes in water, the films or plates should be bathed in a 0.3 per cent solution of ammonia (10 cubic centimeters of 28 per cent ammonia per liter) for three minutes and then washed for two or three minutes. The rate of washing is also increased if a non-hardening or a chrome alum fixing bath is used (see article on *Hardening*).

A very satisfactory hypo eliminator for prints consists of a solution containing low concentrations of hydrogen peroxide and ammonia. This mixture will readily oxidize hypo completely to sodium sulfate, which is harmless. Two formulas known as Kodak HE-1 and HE-2 have been worked out. Their proper use should insure permanency of prints as far as fading due to internal causes is concerned. Formula HE-1 is for general professional and amateur use, while Formula HE-2 is for the commercial photofinisher.

KODAK HE-1

Hypo Eliminator Solution for Professional and Amateur Use

	Avoirdupois	*Metric*
Water	16 oz.	500.0 cc
Hydrogen peroxide (3% solution)	4 fl. oz.	125.0 cc
Kodak ammonia (3% solution)	3¼ fl. oz.	100.0 cc
Water to make	32 oz.	1.0 liter

To make 3 per cent ammonia, dilute 1 part of 28 per cent ammonia with 9 parts of water.

Life of Kodak HE-1 Solution: About fifty 8 x 10 prints or their equivalent per gallon (4 liters).

Important: Prepare just before use, keep in open tray during use, and discard after use.

Wash the prints for about 30 minutes at 65° to 70° F.* in running water which flows rapidly enough to replace the water in the vessel (tray or tank) completely once every 5 minutes. Then immerse each print about 6 minutes at 70° F. in the Hypo Eliminator Solution (Kodak HE-1), and finally wash about 10 minutes before drying.

KODAK HE-2

Hypo Eliminator Solution for Commercial Photofinishing Use

	Avoirdupois	*Metric*
Water	10 oz.	300.0 cc
Hydrogen peroxide (3% solution)	16 fl. oz.	500.0 cc
Kodak ammonia (3% solution)	3¼ fl. oz.	100.0 cc
Water to make	32 oz.	1.0 liter

To make 3 per cent ammonia, dilute 1 part of 28 per cent ammonia with nine parts of water.

Life of Kodak HE-2 Solution: About eighty 8 x 10 prints or their equivalent per gallon (4 liters).

Note: Commercial hydrogen peroxide (Pharmaceutical) should be stored in a loosely stoppered bottle or one with a boreglass tube in the stopper, away from heat and light.

Wash the prints about 15 minutes at 65° to 70° F.* in running water which flows rapidly enough to replace the water in the washing vessel (tray or tank) completely once every 5 minutes. Then immerse each print for about 5 minutes in the Hypo Eliminator Solution (Kodak HE-2), and finally wash about 10 minutes before drying.

When using Pako Print machine (or similar equipment), replace the water in the second wash tank with the Hypo Eliminator Solution (Kodak HE-2), and process the prints as usual.

TEST FOR HYPO

In order to test washed prints for hypo there should be processed, with the batch of prints, an unexposed *white* sheet of photographic paper of the same weight and size as the majority of the prints in the batch. After the final wash, cut off a strip of this sheet and immerse it in a 1 per cent silver nitrate solution for about three minutes. Then rinse it in water and compare it *while wet* in subdued daylight or artificial light, with the *wet, untreated* portion. If the hypo has been completely removed, no color difference should be observed. A yellow-brown tint indicates the presence of hypo.

A very slight change in tone of the prints after using the HE-1 treatment may be prevented by adding 15 grains of potassium bromide to each quart (1 gram per liter) of the bath. A slight yellowing of the whites, undetectable on buff papers, may be minimized by bathing in either a 1 per cent acetic acid solution or a 1 per cent sodium sulfite solution for 2 minutes between the treatment in HE-1 or HE-2 and the final wash. If prints show a tendency to stick to a hot belt dryer, they should be bathed before drying for 3 minutes in 1 per cent formaldehyde solution. Alternatively, 2 per cent potassium alum solution may be used, but this should be followed by a rinse of several minutes in water.

The foregoing treatments properly carried out should insure absence of fading from internal causes. Stabilization against external causes may be effected by using a waterproof lacquer on the print, dry mounting tissues for mounting, and partial gold toning of the image.

* For lower temperatures, increase the washing time. Double the washing time should be used when double weight prints are treated.

IDENTIFICATION PHOTOGRAPHY

James G. Liccion

Photographic Technologist, Industrial Division, Folmer Graflex Corp.

Modern identification photography in personnel work is efficient and comparatively inexpensive and its use is daily expanding. Technics for making photographic pass cards and identification badges and tags in large quantities are explained here.

All illustrations from Folmer Graflex.

See Also Criminology and Police Photography

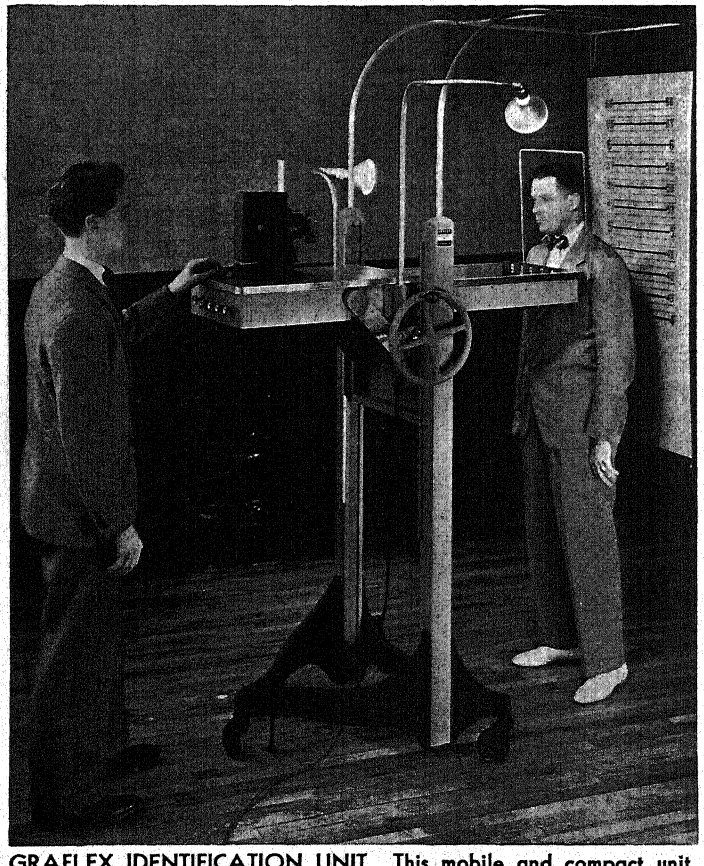
PERSONNEL RECORD or identification photography has been practiced for many years in many different ways. Identification systems have varied from the impersonal type of metallic tabs with stamped numbers, and cards with typewritten description of the employee, to the more positive methods employing photography.

Some of these identification systems used a photograph of the individual that was merely pasted on a pass card with a typewritten description. This system does not afford any positive protection because the original could easily be "floated off" and replaced by a different photograph. Some of the larger industrial plants had difficulty with their old systems of personnel identification, because it was not hard for anyone to enter a plant without the proper authority.

However, since the coming of World War II with its serious dangers of fifth column activities, saboteurs, and spies, it became evident that *positive* identification of all employees was of vital importance. With our enormous problem of National Defense and with so many industrial organizations both large and small so actively engaged in this vital work, both the government and industry came to the conclusion that the most certain method of safeguarding their personnel and their secrets was through photography.

GRAFLEX IDENTIFICATION UNIT

Although this record photography could be accomplished under difficulties with much of the photographic equipment available, there still was needed an identification camera that would make this work a routine job in an efficient, economical way for large numbers of persons and still be simple in operation. The Folmer Graflex Corporation developed the Graflex Identification Unit. This unit is completely self-contained and is almost automatic in operation. Because of its simplicity, as many as 200 persons per hour can be photographed. It is intended for rapid, inexpensive production of head-and-shoulder identification pictures on 35mm film. The limit of its operating speed is only a question of how fast the individuals can be brought before the camera. Standardized focus, lighting, and exposure eliminate the need of an experienced operator. The lighting is of a balanced portrait type, eliminating the flat characterless pictures that are so often made as identification pictures. The height of the individual, his payroll number, and any departmental designation may be included in the negative.

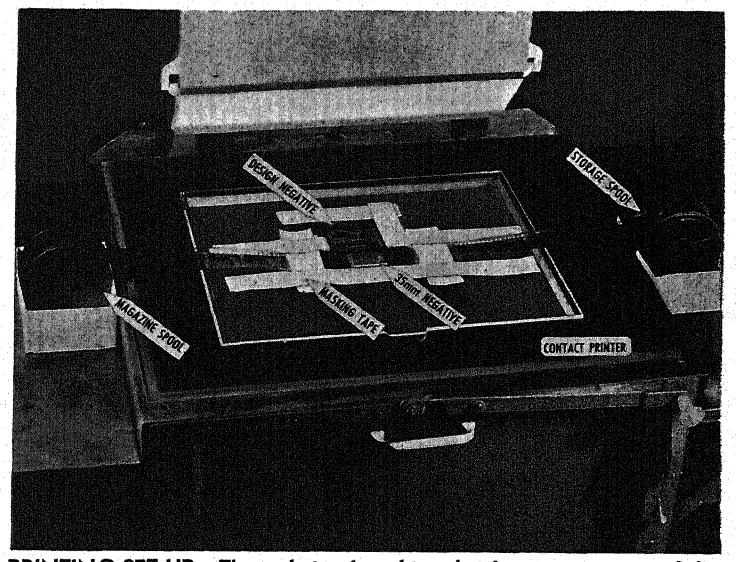


GRAFLEX IDENTIFICATION UNIT. This mobile and compact unit, fully described in the text, can photograph as many as 200 persons an hour

The negative may be printed by contact to make either an all-photographic pass card, a tamper-proof badge, prints for use in personnel files, or it may be enlarged for other purposes. The camera magazine will accept up to 100 feet of 35mm film, making 8 exposures per foot or 800 pictures for one loading. The entire unit is mounted on rubber-tired casters so that it may be easily rolled from department to department, thereby saving employee time. The use of 35mm technic in film development

and printing is an economic factor of great importance.

The Graflex Identification Unit consists of a camera with a 75mm f/4.5 prefocused lens. The recommended shutter speed and diaphragm opening are clearly marked in red on the front of each shutter. The magazine, accepting up to 100 feet of 35mm perforated film, is attached to the camera by a slide lock. An exposure counter on the magazine indicates at all times how many exposures have been made. A groundglass focusing panel can be attached to the camera in the same manner as the magazine, so that proper alignment can be checked before actual operations are begun.



PRINTING SET-UP. The technic of masking the design negative and the 35mm portrait negative is shown. This is the set-up for a pass card

The operating arm has two simple movements for the picture-taking cycle. Pushing the arm forward makes the exposure; pulling the arm back advances the exposed film. Automatic interlocks prevent the shutter from working until the exposed film has been advanced and prevents double exposures.

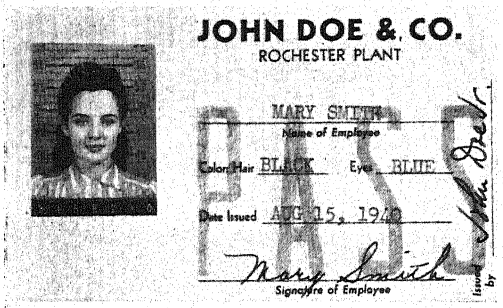
The camera stand consists of two upright columns of wooden construction. Attached to the ends of the columns is a frame of heavy tubing which supports at a fixed height a background screen scaled to indicate the height of the individual. An elevating platform supports camera and magazine, numbering device, and lighting system. It is lowered and raised by a rack-and-pinion.

The lights are balanced for good portrait lighting and, because they are attached to the movable platform, they are automatically raised or lowered for the different heights of each individual. This makes the lighting uniform in all cases. The numbering device has seven digits, and it is controlled from the operator's end of the platform. A wire frame mounted on one end of the platform, within which each individual is properly framed, simplifies proper positioning of the camera for individuals of various heights. A mirror next to the lens helps the subject to center himself and to assume a natural expression.

PRINTING

Tamper-proof pass cards and badges of many varieties are made from these 35mm negatives. In order that pass cards may easily fit the average billfold or card cases, dimensions of about 2¼ x 3¾ will be found very satisfactory. These cards may be made all-photographic in one process. First, one should make a master design negative with the legend that is to be included in the final pass card. This negative should be of high contrast (Kodalith film will give excellent results), and should have a clear window the size of the portrait negative.

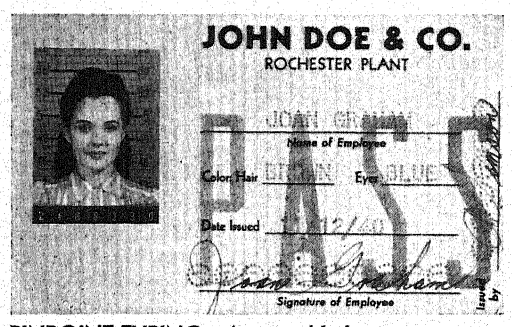
The set-up for the actual printing can very easily be made on most standard printers with the aid of a little scotch tape. The master design negative is taped down, and the roll of portrait negatives is positioned so that single negatives may be placed within the clear window of the master design negative. After making the exposure, the next portrait negative is moved in place. If a good master design negative is used, it will be found that the proper exposure for the portrait negative will be sufficient for the legend on the Kodalith negative. In order to make this a one-exposure process, it must be mentioned that no legend should be included either directly below or directly above the space occupied by the portrait.



ALL-PHOTOGRAPHIC CARD. When the identification photograph and the name and other data are printed together from one combination negative, tampering is practically impossible

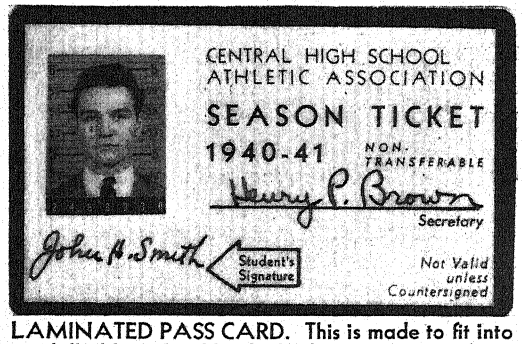
DESIGNS

Pass card designs can be varied in many ways. Some will want the simplest possible card, including only employee's name, company name, and employee's number. Others will want to include more detailed identifying information such as employee's date of birth, color of hair and eyes, and even a thumbprint of the individual. In an attempt to frustrate malicious attempts to alter pass cards, many methods can be applied. Some companies are impressing the pass card with the company seal. Some are using pinpoint typewriters for typing employee descriptions. These typewriters perforate the emulsion, so that erasure presents a difficult problem. Others are having their pass cards laminated between two pieces of celluloid. This last process is one of the most tamper-proof as well as one of the most costly.



PINPOINT TYPING. As an added precaution, pinpoint typing which actually perforates the emulsion may be used

Badges have been used for some time for identification, and they are more and more popular because of their many advantages. In certain instances the management requests all employees to wear identification badges at all times so that their inspectors can see at a glance whether or not one "belongs." If, as is often the case, badges of different colors are desired to designate a department or building to which employees belong, this can be accomplished by the use of colored masks. When using these colored masks, strip prints are made from the negatives and the masks have an opening or window of the proper size. These masks are positioned over the photo, and the badge is assembled. The masks can either be plain in color or they can contain whatever printing matter is desired.



LAMINATED PASS CARD. This is made to fit into billfolds and is, like the badge, tamper-proof

Badges can be had in many shapes, sizes, and materials. Some are metal and celluloid, and some are all-metal. One big advantage of badges for identification is that any attempt to alter the badge will usually destroy it beyond redemption. This, of course, makes this type of identification quite tamper-proof.

Both the photographic badge and photographic pass card are now being used almost universally by our industrial organizations and government agencies. Even our schools are using photographic identification on a large scale, attaching the photographs to student records for their files and by making photographic season tickets for athletic



TAMPER-PROOF BADGE. A contact print of the identification photograph and data may be bound to a celluloid-covered pin or badge

events to prevent use by unauthorized persons.

Besides personnel record photography playing such an important part in our industrial plants, government agencies, and schools, it is used extensively by our law enforcement officers throughout the country. In almost all cases, several different views are made of all criminals for police records (see page 1103). Much identification photography is also done by studios for use with passports and hunting and fishing licenses.

INCIDENT LIGHT MEASUREMENT

G. C. Anderson

Meter Department, General Electric Co.

There are two major ways of measuring light in photography—by measuring the light which is reflected *from* the subject or by measuring the light which falls *upon* it. For the latter, read this interesting article, an account of the theory and method of measuring light as it is incident upon the subject.

For the reflection measurement, see Exposure. See Also Color Temperature

PROPER EXPOSURE for some photographs can be determined more accurately by measuring light *falling on* the subject than by measuring that *reflected from* it. This method is known to professional photographers as incident light measurement.

A basic fundamental to remember in making pictures is that light falling on the subject determines exposure, while light reflected from the subject makes the exposure. Obviously, if we have a certain light illuminating a subject, there is a certain basic exposure that will produce a satisfactory negative. If we double the amount of light falling on the subject, the exposure time will simply be half. Therefore there is a definite relationship between the light falling on the subject and the light being reflected. This condition holds true without exception.

Under ordinary conditions the incident light method and the reflected light method give similar results. But in cases where the subject is in very dim light, presents extreme contrasts, or is either very light or very dark, the incident light measurement method has definite advantages. It will measure light at levels below any that can be measured by reflected light. Important from a practical standpoint is that it requires but one measurement, whereas the reflected light method may require two—for highlight and shadow. The accuracy of its measurement is increased by the fact that the reading is actually made at the subject position (or at a reasonable substitute position), obviating the possibility of error likely in pointing a meter from camera position at many parts of a scene to measure reflected light.

MEASURING INCIDENT LIGHT

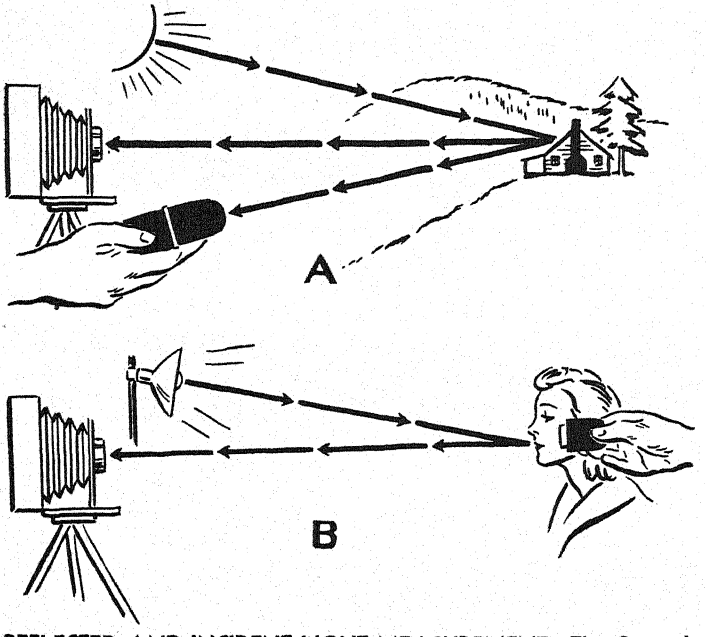
The ideal solution, of course, is a meter which will measure both incident and reflected light. This provides a choice of measurement method for average conditions, and a simpler, more accurate method for difficult conditions.

Incident light measurement is not a new idea. In fact, it was the first light measurement method used in photography. The need for an exposure measuring device was recognized soon after the first photographic emulsion was invented. Shortly afterward, exposure tables in various forms made their appearance. The first of these consisted of charts indicating correct exposure for certain light conditions and types of subjects. All of these tables were based on the incident light illuminating the subject. To use the charts, the photographer estimated the type of subject, and the chart indicated the exposure. But the inaccuracy of human judgment left too much to chance, and the charts were not generally satisfactory.

The first exposure meter was of the extinction type. There have been several variations of this meter, but in general they follow the basic principle of holding the meter up to the eye and adjusting it to match reflected light as a means of calculating exposure. The extinction type of meter improved the chart method, but the combined limitations of the eye and reflected light measurement still left room for error.

REFLECTED VS. INCIDENT LIGHT MEASUREMENT

Invention of the photoelectric cell permitted measurement of light with an electrical instrument and paved the way for a truly accurate meter. The photoelectric cell has a sensitivity similar to that of the average photographic film. Light falling on the



REFLECTED AND INCIDENT LIGHT MEASUREMENT. The General Electric Meter is shown, in *A*, being used with the hood to measure reflected light from the camera position. In *B*, the same meter is used without the hood to measure incident light from the subject position. In the first case the calculator should be set at the "closed cover" arrow; in the second it should be at the "dim light" arrow

cell is converted into electric energy. Attachment of the cell to an electrical instrument provides the basis for the modern photoelectric exposure meter. Thus the operating principle of both the reflected light meter and the incident light meter is the same. *The difference is the angle of light measured.*

The most accurate reflected light meters measure only the light seen by the camera lens. Incident light meters, on the other hand, measure all the light falling on the subject. This difference is important and is the reason why reflected light meters cannot be used directly for incident light measurement.*

* Light comes from a source of illumination, the intensity of which determines the level of illumination. *The amount of light falling on the subject is reduced as the square of the distance from the source.* There is only one-quarter as much light two feet from a scene as there is one foot away. This incident light is measured in foot candles.

The subject reflects some of the light falling on it and the amount of light reflected determines the brightness of the subject. This reflected light is measured in *candles per square foot.* The light reflected diminishes as the square of the distance, but the area of the scene increases as the square of the distance, and therefore the reflected light is equal as the distance increases from the subject.

Incident light measurements are made with the meter in the position of the subject and *pointed directly at the camera.* The photoelectric cell in the incident meter is exposed to an angle of view of approximately 180 degrees, as compared with its intentionally recessed position in the hood of the reflected light meter which is designed to measure the restricted angle of light approximating that entering the camera lens.

In photographing some outdoor scenes, of course, the subject may be too far from the camera or otherwise inaccessible for actual incident light measurement. This difficulty may sometimes be overcome by using the reflected light meter to obtain a simulated incident light measurement. This is done by measuring the light reflected from a neutral-colored surface (such as the hand) held in the subject position or direction, and is a semi-satisfactory means of converting the reflected light meter to measure incident light. For more on this method, see *Exposure Meters*, page 1634.



GENERAL ELECTRIC METER. Set for incident light readings, with the hood removed to give almost a 180° angle of acceptance. Notice the light values scale, given in foot candles

USES

A particularly useful application of this system of light measurement is with poorly lit subjects, where the level of illumination is so low that the amount of reflected light is practically nil. A much higher reading would be obtained by measuring the incident light. In many cases in dimly lit interiors the bright part of a scene is the most important and the rest is a large black background. This measurement is simple when using the incident light system. A similar condition is true when the subject is a small dark object on a large white background.

The most extensive use of incident light measurement is by professional motion picture studios. Here, exact exposure is essential for economic reasons. In addition to saving time and money, it serves as a constant check on quality. In movie making, exposure must be exactly determined for each scene so that the final footage will have a constant tone from start to finish. Exposure readings for every scene are carefully recorded so that any one of them can be duplicated if a retake is necessary. Thus motion picture cameramen use incident light measurement to determine correct exposure, and also to maintain a constant light condition on the scene. It permits control of the highlights and shadows in every take, and facilitates a constant tone negative in spite of such variables, for example, as costume changes of the characters for different scenes. Incident light measurement has been found to be the best method for maintaining a constant flesh tone regardless of whether the principals dress in light or dark attire.

The advantages of incident light measurement in motion picture photography also hold true in still photography for consistently duplicating negative tone and contrast.

The important thing to remember in using either the incident light method or the reflected light method of measurement in photography is that neither is an end in itself, but merely a step in the process of obtaining pictures as perfectly exposed as possible. Correct choice and use of the method better suited to the particular conditions under which any photograph is to be made is just good assurance that the step taken is one in the right direction.

INDUSTRIAL PHOTOGRAPHY

Dmitri Kessel

Industrial Photographer for Life, Fortune, *and other publications*

Dynamic and modern industry can be effectively portrayed by the forceful use of modern photography. A photographer who makes his living by interpreting this phase of present-day life tells about the point of view needed. Also about subjects and angles . . . interior work . . . procedure for heavy and light industrials . . . use of distortion . . . equipment and general suggestions. How to cover the steel and oil refining industries are two of the specific examples.

All photos by Dmitri Kessel.

See Also Commercial Photography, Institutional Movies, Machinery and Engineering Photography, Production Photography in the Aircraft Industry

INDUSTRIAL PHOTOGRAPHS are made to serve either of two purposes. They may be commissioned by an individual plant for its own records or publicity, by a newspaper or magazine for editorial purposes. The interests of these two buyers of pictures of industry are somewhat different and will therefore affect the type of pictures made for them.

A business man or an advertising director naturally wants his plant presented in the best possible light. He is interested in showing the particular efficiency of his workers and machines, the coordination of various departments of production, and any other factors suggesting the neatness and orderliness of the plant organization. On the other hand a magazine which wants to illustrate a story on industry does not emphasize the presentation of a factory in any preconceived way. More or less of a candid treatment is indicated. Dramatic highlights are eagerly sought, interspersed with elements of human interest.

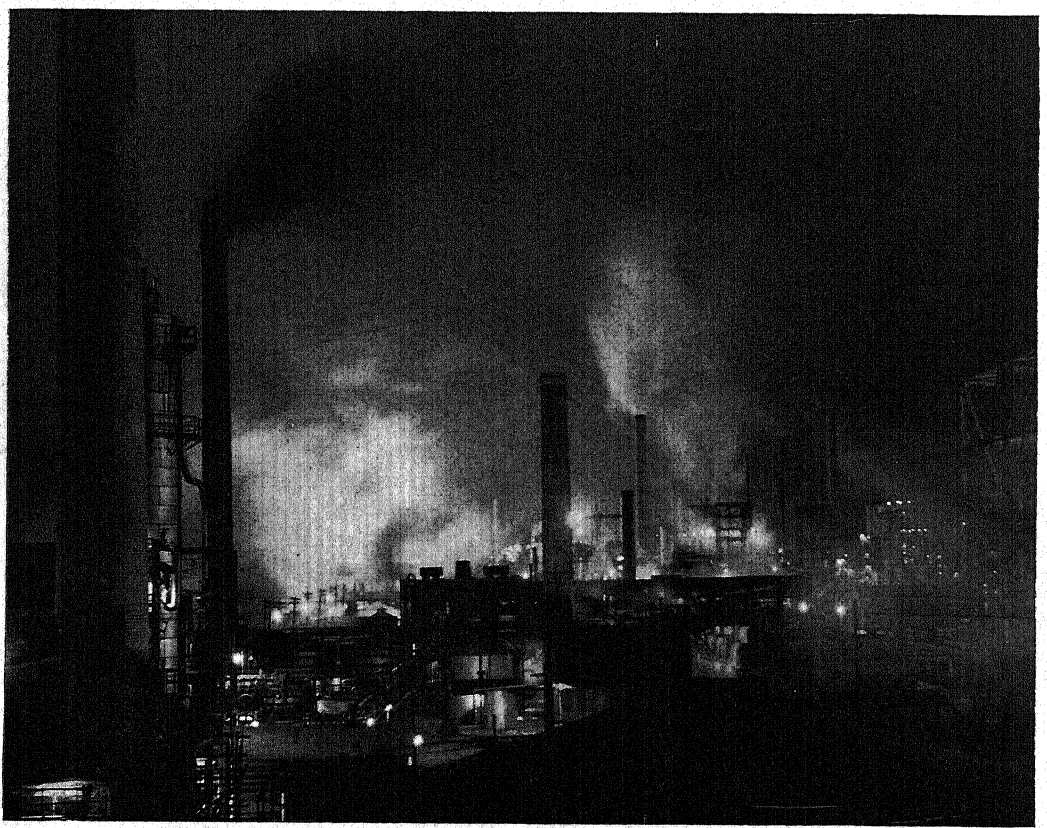
The photographer of industry, moreover, must realize that his approach is not only governed by the plan of the employer, but also limited by the information to be given out. Many industrial plants have processes which involve trade or military secrets and these must be carefully preserved. The photographer therefore may be called upon to avoid certain subjects—often at the cost of a good deal of time and trouble. He may have to throw an important serial number out of focus or leave out a special piece of machinery by choosing another angle or point of

view. And, of course, any such operations which he happens to see are to be kept in strictest confidence.

It is up to the photographer to figure out the most telling parts of a process and by means of his lighting and camera angles give the story as much punch and dramatic emphasis as he can. There are some factory situations, of course, which, because of their unique nature (ladling steel, for instance), can only be recorded in a specified way. However, the equipment is pretty much the same whatever the type of job, and the technical problems by and large are quite similar.

My own chief interest in the field is to express with all the means at my command the dynamic forces (exemplified by industry) molding our civilization. The question of the superhuman power wielded by machines is in itself a fascinating one. But the pleasure derived from observation of the smooth working parts of a machine—the seemingly intelligent comings, goings, and turnings of pistons, cogs, and gears, while all the time a useful object is taking shape in its vitals—is, as far as I'm concerned, even more to be marvelled at. I believe that some of this wonder and marvel must be in a man if he is to make a good industrial photographer. It is the only drive which will enable him to undergo the very real rigors associated with this branch of photography. For let it be understood at the very beginning that photographing industry, no matter how intriguing the subject, is not all breathless adventure. A man will need all the patience and endurance he possesses, combined with his love of the work, to carry him through what are probably the most gruelling conditions a photographer can be called upon to face.

Nine-tenths of his work will be downright physical toil. He will spend most of the time lugging his equipment over mounds of slag,



NIGHT WORK. An example of the effectiveness of industrial pictures made at night. DATA: 3-1/4 x 4-1/4 camera, fast pan film, 2 seconds
***Photo from* Fortune**

walking up and down long staircases, inhaling a variety of obnoxious chemical vapors, impregnating his clothes and skin with coal dust, gravel, grime. These privations will be interspersed with moments of feverish focusing, snapping shutters, changing films. But the few minutes of exhilaration, beside a Bessemer converter spitting flames against a black night sky or a blast furnace discharging a cargo of liquid steel, will more than repay him for the backbreaking labor involved. This phase of the work makes no great technical demands. A clear eye, a steady hand, some sense of the dramatic values of the subject, and an ability to compose quickly, are the surest assets.

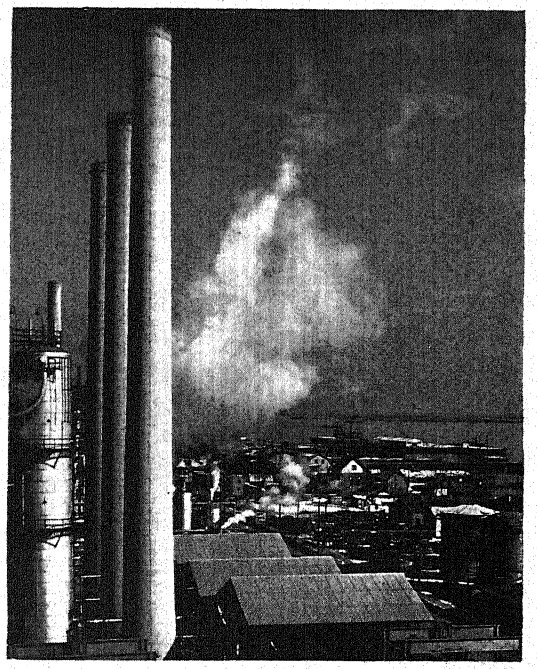
SUBJECTS AND ANGLES

Suppose we take an actual case. Let us assume our photographer has selected a particular factory, such as a steel mill. If he is interested in the exterior pictorial elements, he will find no end of opportunities. The serried rows of smokestacks, the blackened looming shapes of blast furnaces, the network of rails threaded through the complex maze of yards, sheds, cranes, conveyors, etc.

Dramatic quality in these pictures will be aided by discreet use of filters. He will notice that the squat forms of furnaces gain vitality against a stirring cloud-patterned sky. Long gaunt smokestacks belching columns of smoke are similarly affected. However, he may wish to treat a network of conveyors or girders otherwise. In this case, a clear sky given the proper gradations of gray to black by the use of a red filter will serve to set off the stark, abstract shapes.

A wide-angle lens may be useful occasionally in shooting a long row of structures, such as furnaces. If used at oblique angles the lens tends to exaggerate perspective and add dynamic force to the picture. The swing movements of the camera come into play with the use of this lens to correct distortions and maintain the parallelism of vertical lines.

Conscious distortion is often resorted to, either for purposes of composition or where an effect of great height or power is desired. A smokestack, for instance, may be treated this way. Set your camera up directly under the stack and compose in your groundglass so that its entire length is visible, tilted if you so desire. You will find that the sudden convergence of its lines has a startling effect. Smoke issuing from its mouth, combined with the illusion of great height, produces an overpowering effect, akin to that of a volcano in eruption.



SUN OIL CO. REFINERY—LONG VIEW. To give a complete coverage of an industrial subject, the plant's locale should be portrayed. Here is an oil refinery, with smoke pouring out from behind the tall stacks to give atmosphere. A filter was used to darken the sky and bring out the smoke. DATA: 1/100 second, f/16, K-2 filter
***Photo from* Fortune**

COKE PLANTS AND OIL REFINERIES

The photographer in search of spectacular outdoor pictures for his portfolio must visit coke plants and oil refineries. The installations characteristic of these plants are to some extent similar, but with some important variations. The essential difference between them lies in the great violence of the process occurring in the coke plant as against the complete immobility in an oil refinery. The chief attraction in the latter is the fantastic, almost surrealist grotesqueness of the forms of cracking units, the maze of silver painted pipelines and diverse towers, cisterns, reservoir tanks, etc. At the moment, however, the coke plant which contains a very interesting phenomenon will engage our

attention. A short description of one will be helpful.

As one walks through the grounds one notices several predominant features. As in a steel mill, groups of furnaces play an important part; also one observes an unusual number of conveyors joining various buildings; then there are great mounds of coal with nearby cranes for loading and unloading. The units which will probably intrigue you most are the coke furnaces and quenching station. Again, as in the steel mill, the emptying of the furnaces provides the high spot. In initiating this action, a long metal arm is thrust slowly into the interior of the base of the furnace forcing the white hot coke into a large steel car on rails stationed underneath. As the sputtering coke tumbles out, clouds of steam are released which at times obscure everything. Since this takes place in the open, no auxiliary light is necessary. Several good shots are to be had at various stages of this operation.

When the first trickle of coke begins there is, of course, a swirl of steam but not sufficient to blot out the works. If shot at this point, the picture is composed essentially of the squat, black forms of the furnaces and the lone car underneath receiving the white seething lava with complete imperturbability. When filled, the car moves toward a squarish brick building which is tunneled through, and comes to stop at the center. Streams of water are then released through a sprinkler system overhead and the entire car is drenched. The effect of this treatment is worth a 50 mile trip in any direction at any time. As the water descends on the superheated coke, tremendous billows of steam roar out of the tunnel and leap several hundred feet into the air. The pressure is so great, the upward surge so irresistible, and its duration so short that it's necessary to work at top speed to record it in some measure. Should the photographer be fortunate enough to have a clear blue sky as a backdrop, a K2 filter should be sufficient to record the columns of steam. It's a good idea also to overexpose somewhat and underdevelop, since this combination generally softens or flattens the gradations within the steam clouds. The shapes of these clouds are so rotund and their modeling so marked that half the picture is lost if the negative be too contrasty.

The problems in an oil refinery I found to be mostly compositional. The subject matter is so inherently pictorial that I'm almost tempted to say "Point your camera in any direction and you'll get a picture." The opportunities for bizarre angles are unlimited.

(Continued on page following insert)



COMPOSITION ANALYSIS for . . . STREET OF FLAME

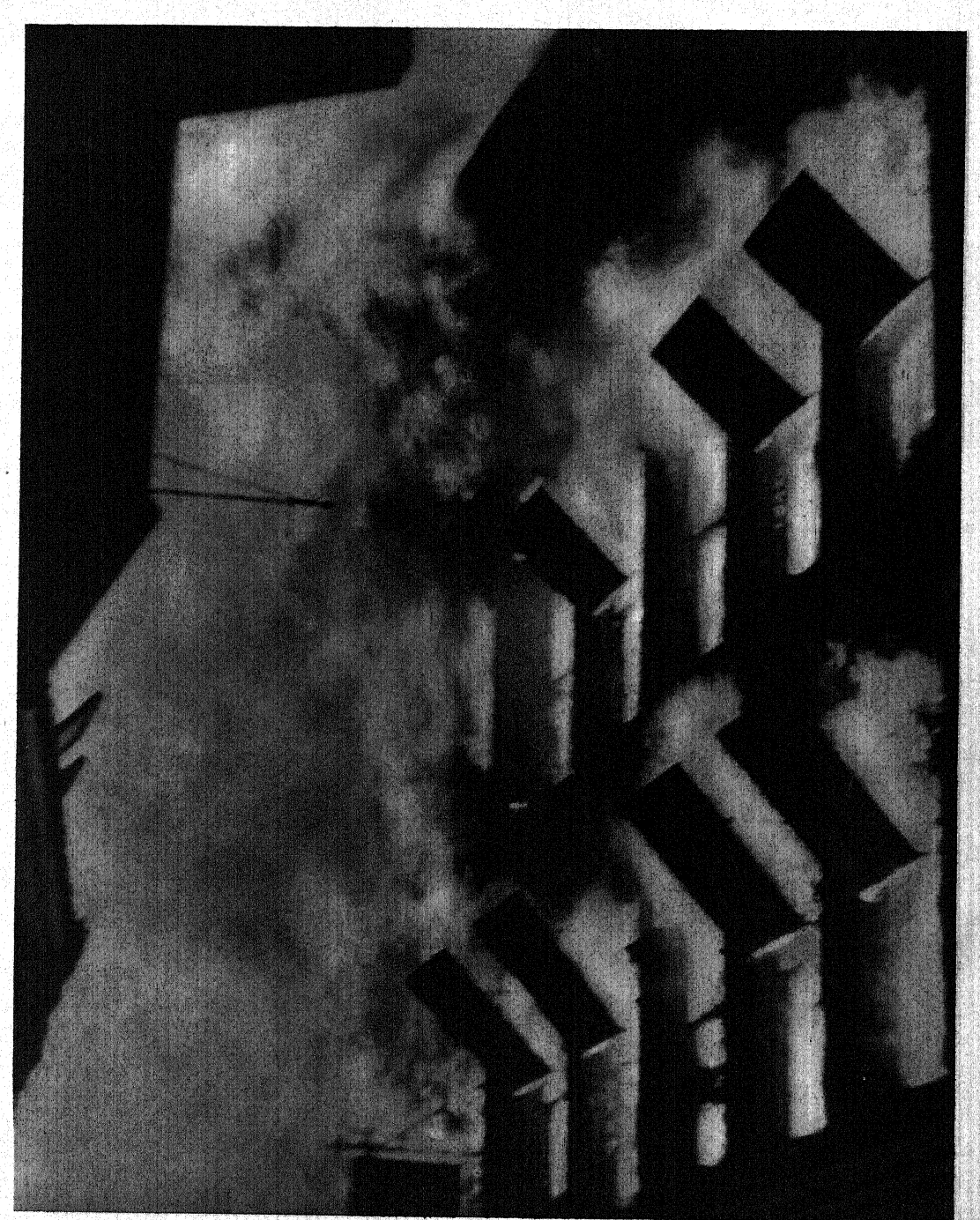
This photograph was probably made under circumstances which made any concentration on esthetic qualities improbable. The recording of the destructive effect of incendiary bombs was its purpose. Among the many news photos from the different war zones, this shot deserves to be singled out for its unusual result.

The dramatic effect of contrasts is so obvious that it needs no further explanation. The powerful rhythm of the windows and the dark reflectors against the glowing masses of flames also speak too eloquent a language to demand further analysis.

What makes this picture unique is that as an authentic photograph of an actual event it produces an effect strangely similar to paintings of the early Cubist School during the first quarter of this century. Picasso, Braque, and other pioneers of that school went through a period of experimentation with abstract form elements. Their compositions consisted entirely of rectangular and other sharply defined shapes connected by areas of more or less irregular, spotted texture. To the general public those abstract pictures seemed at the time like the most unreal nightmares of irresponsible brains. Few people would have believed that straight photography would some day, without tricks, produce a record of an actual event with a result almost identical with some of the pioneer work of modern art.

Isn't this like an invitation for photographers to show a greater interest in art? I believe that every photographer of ambition should insist on acquiring an artistic background just as every artist should be interested in the possibilities of photography. Can we imagine Leone Battista Alberti, Leonardo Da Vinci or Albrecht Dürer, those giants of the Renaissance, if they lived today, not devoting a great part of their genius to still and motion picture camera work? On the other hand, would Hill, Stieglitz, Steichen, Sheeler, and others ever have achieved what they did without their intimate contact with art?

Leo Katz



STREET OF FLAME — PRESS ASSOCIATION, INC.

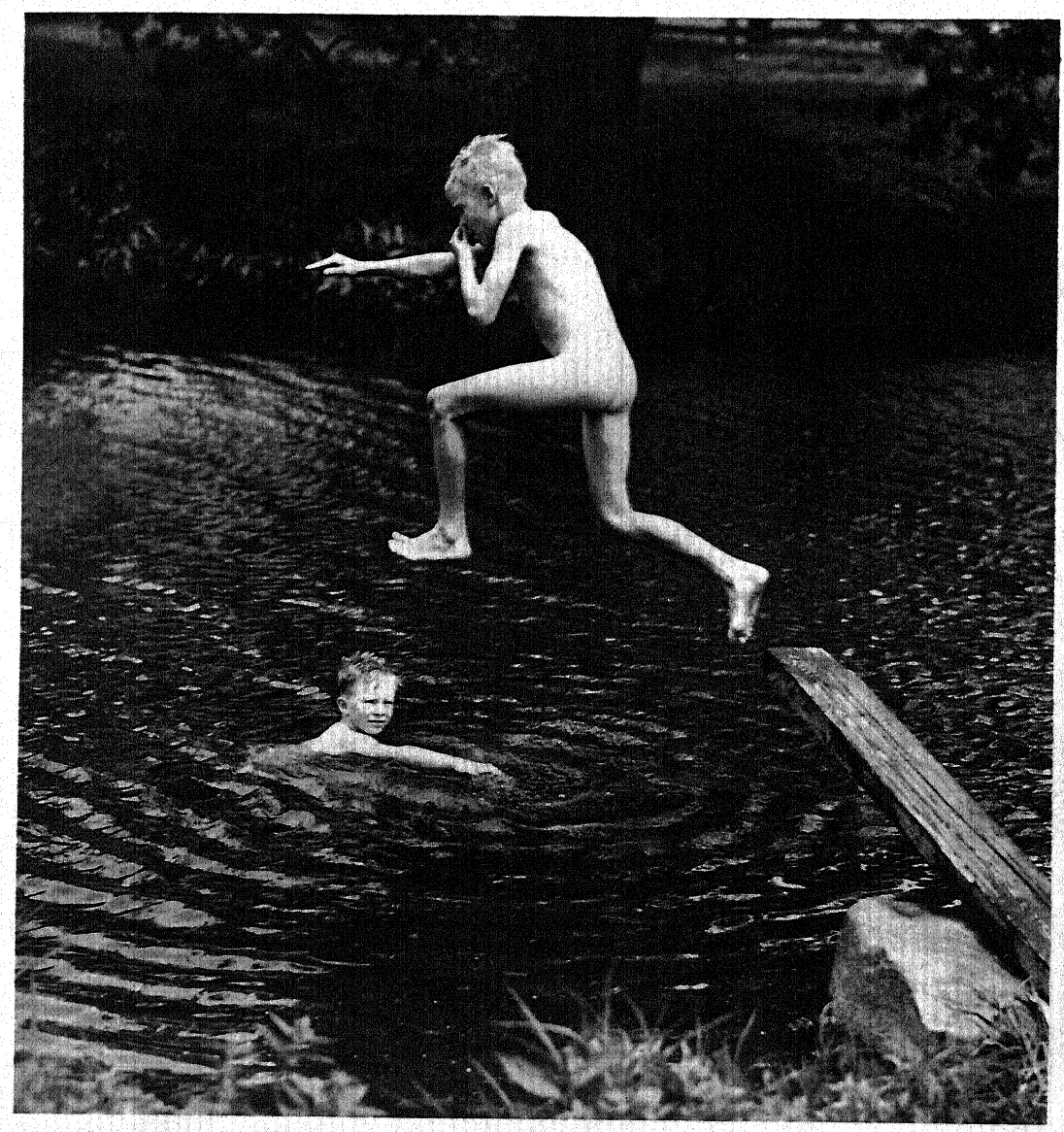
A news photograph taken in London after a fire bomb raid, December 29, 1940



C'MON IN!

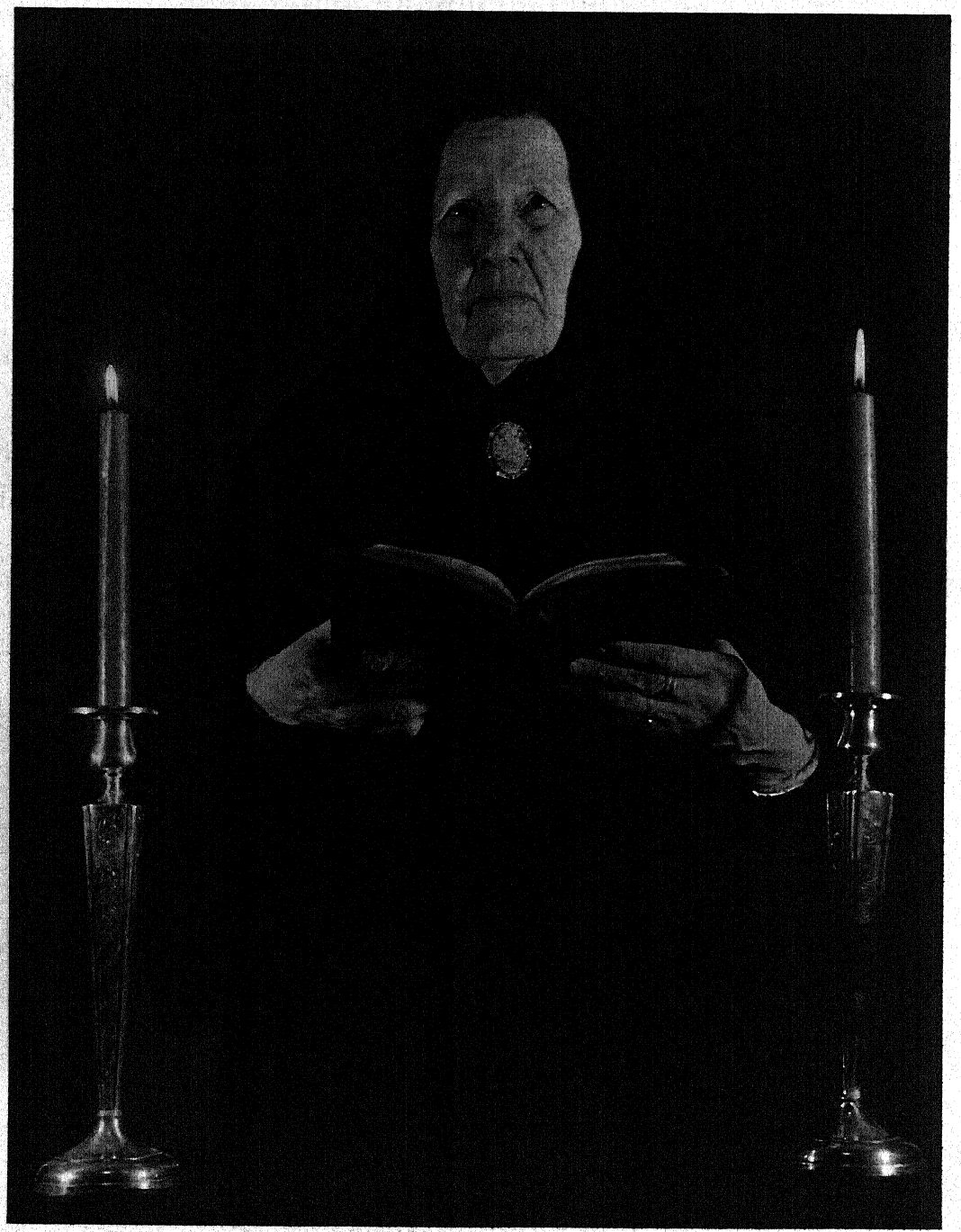
REMIE LOHSE

A good story-telling photograph—this is extremely well composed. Notice the position of the two swans, in the circle made by the girl and the board. And, of course, the perfect diagonal relationship between the boy and girl



SWIMMING HOLE — HAROLD M. LAMBERT

Here is the old swimmin' hole personified. The white nude figure of the boy in mid-air and his awkward position—topped off by the nose-holding gesture—are the center of interest, of course. But the other boy and background are important, though the latter is definitely subdued



EVENING PRAYER **DOROTHY GALE**

A straightforward interpretation of religious faith, this is the more moving because of its simplicity. DATA: 3¼ x 3¼ Linhof, 5½-inch Goerz Dagor f/6.8 lens, fast pan film, ½ second, f/7, two No. 1 photofloods

(*Continued from page preceding insert*)

Climb a tower 3 or 4 stories high and you can fill your groundglass with the tops of oil tanks, a type of picture you won't see again for many a moon, except from an airplane. Point your camera up and you find yourself stalking a monster of a cracking plant that resembles some of the less amiable denizens of prehistoric jungles our leading paleontologists cook up from time to time. There are clusters of pipelines of all sizes running on the ground, through air, crisscrossing and interweaving. You'll probably want to spend several days around the place, so don't shoot up all your film on the first lap.

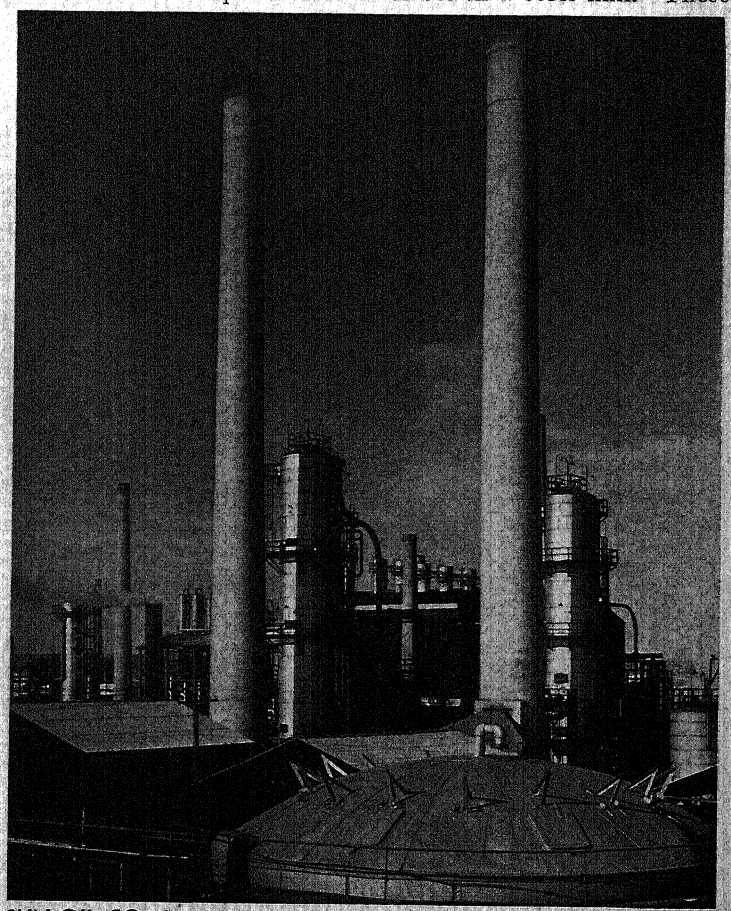
INTERIOR WORK

Having considered some of the exterior possibilities, we can now take some of the more technical problems of interior industrial photography. Before discussing specific pictures, I think it would be worthwhile to outline a few simple rules to be followed. The floor of a factory is usually crowded with machinery, implements used to manipulate the machinery, and a varied assortment of materials. To one interested in making pictures, not merely records, very difficult problems of selection and elimination present themselves. The problem of selection generally narrows down to a particular machine or part of a machine, while elimination entails maneuvering the camera, shooting up or down to get the best angle or to cut out unrelated objects. With a little practice one acquires the knack of sizing up an interior quickly, ferreting out perches such as towers, scaffolds, cranes to be used later as shooting positions and angles which often greatly enhance the drama of your pictures.

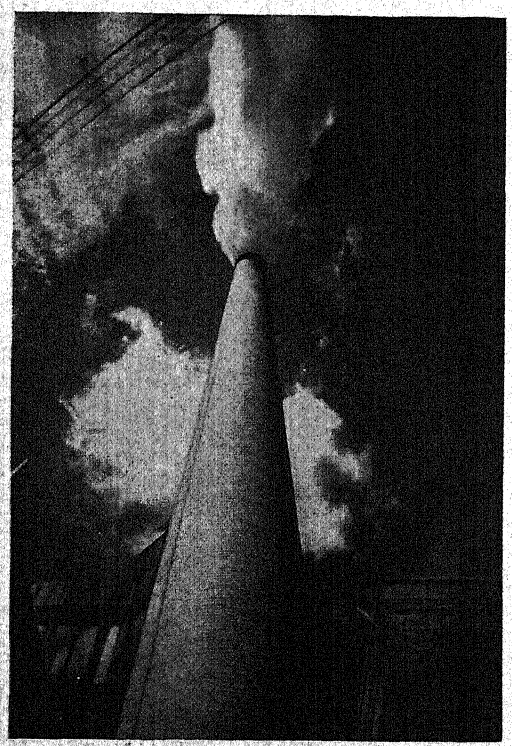
Lighting also plays a part in this matter. Generally it can be said that synchronized flash is best when used quite close to the subject without spreading around much. Factory interiors are often quite spacious, though dim and murky, especially in heavy metal industries. Because of the minimum reflection from wall and ceiling, a great deal more light must be available than ordinarily. The constricted conditions in these drab, cramped interiors also compel one to work for close-ups showing details of machines or processes. This type of groundglass cropping emphasizes function, eliminates distracting parts, and centers the attention on essentials.

PHOTOGRAPHING A STEEL LADLE

Sooner or later you run into a group of open-hearth furnaces in a steel mill. These



SUN OIL CO. In this outside view, forms and textures of a refining plant are featured. DATA: 3-1/4 x 4-1/4 camera, wide-angle lens, f/100 second, f/16
Photo from Fortune



DISTORTION SHOT. A wide-angle photograph, showing how distortion can be used to dramatize an ordinary subject like smoke pouring out of a smokestack. DATA: 3-1/4 x 4-1/4 camera, 1/2 second, f/42, G filter

are arranged in rows inside a steel skeleton structure which is really a shed. They are loaded periodically with pig iron and other ingredients which, after appropriate processing, are tapped off into a great steel ladle. The tapping of these furnaces presents perhaps the most spectacular sight in all industry and has had no mean attraction for amateurs and professionals for as long as I can remember. It is well to study their operation awhile before making any attempt to take pictures. As the time set for unloading approaches, an unusual activity begins in the neighborhood of the furnace. Workers come in and take up various posts. The ladle, suspended from a huge crane, is lowered slowly under the shaft from which the molten steel will issue. A tenseness pervades the dim, gloomy interior. Suddenly, a stream of intensely bright, boiling material gushes forth, lighting everything up with an eerie glow. Sparks shoot out in all directions as the ladle fills and it is quite dangerous to be within 15 or 20 feet of it. When the ladle has been filled, it is transported to a series of large molds into which the steel is poured. As the metal cools, it takes the shape of ingots.

After watching the display of fireworks, you itch to get to your camera and take some pictures. One additional piece of equipment is necessary at this point—synchronized flash. Its use is mandatory, as I found from my own experience. Though a great deal of light does radiate from the molten steel, it is far too little to compete with the brilliance of the metal. To shoot directly into it without auxiliary light will produce ghost images and fog similar to that produced when shooting into the sun.

To meet this situation a set-up of 8 to 10 medium-sized flashbulbs about 15 feet away is suggested. An exposure of 1/100 second at f/16 will allow sufficient underexposure of the flow of steel to reduce its opacity relative to that of the ladle. A soft-working developer such as D-76 is absolutely essential if some balance of opacities is to be attained. As a result of the procedure outlined the form and texture of the ladle will be brought out in high relief, instead of the mere indication of its silhouette; the stream of steel will be reasonably stopped, so that blurring of its gradations does not result.

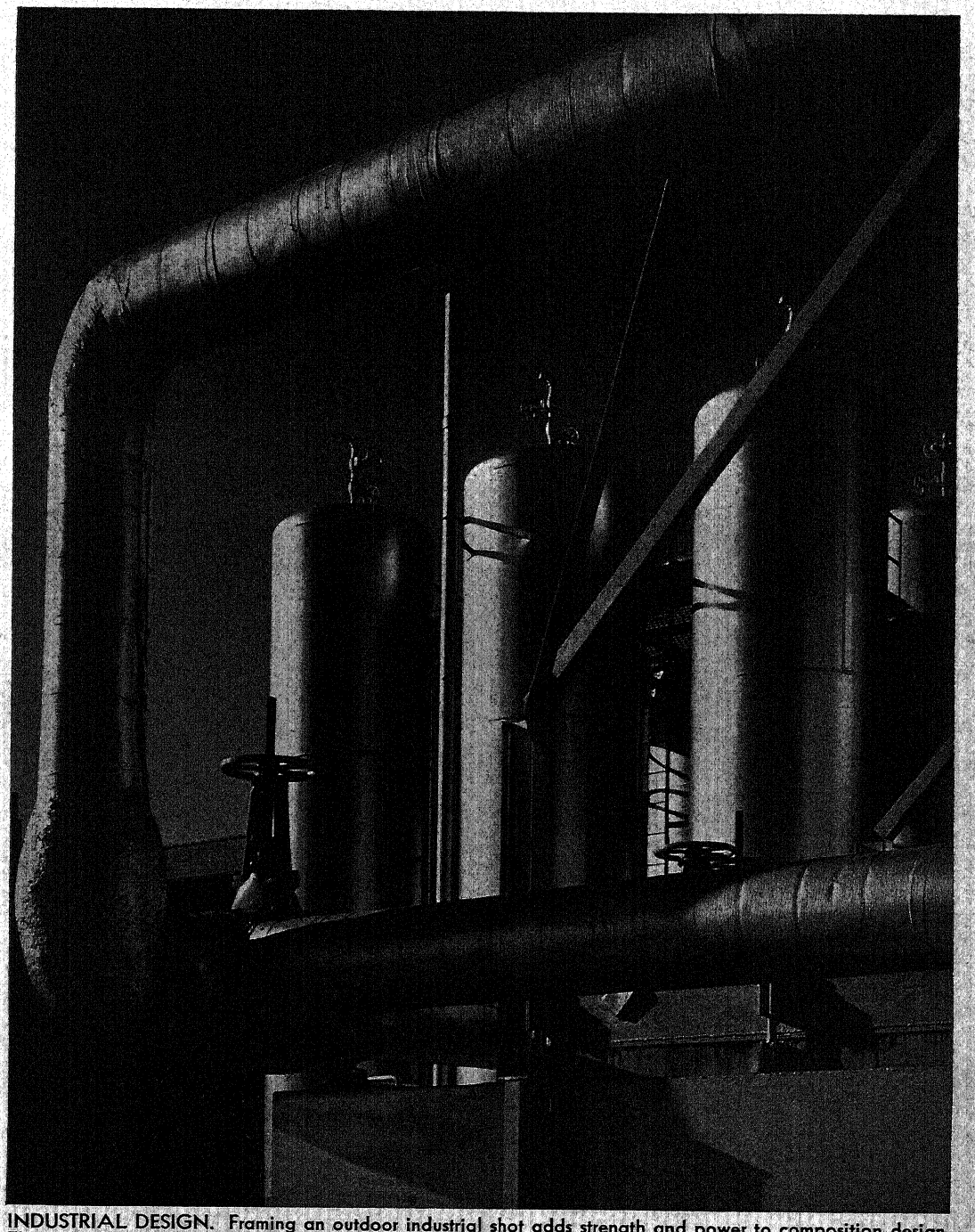
Another and perhaps more desirable angle than shooting from the ground may be tried. Shooting down on the ladle gives you a view of the interior, and is somewhat unconventional since most pictures of the operation have been taken from the ground level.

Just a word of advice concerning the actual shooting. Lay your film out so that it is within easy reach, a receptacle being provided for exposed film (if cut-sheet film is being used). Filmpack, however, seems to be the logical choice because of the ease of changing. It would be most helpful, too, to have some assistance in changing bulbs. The need for these precautions is obvious since the operation lasts only a few minutes and quick action is necessary for its duration.

PROCEDURE FOR HEAVY AND LIGHT INDUSTRIALS

For the sake of convenience in this discussion, I have distinguished industrial

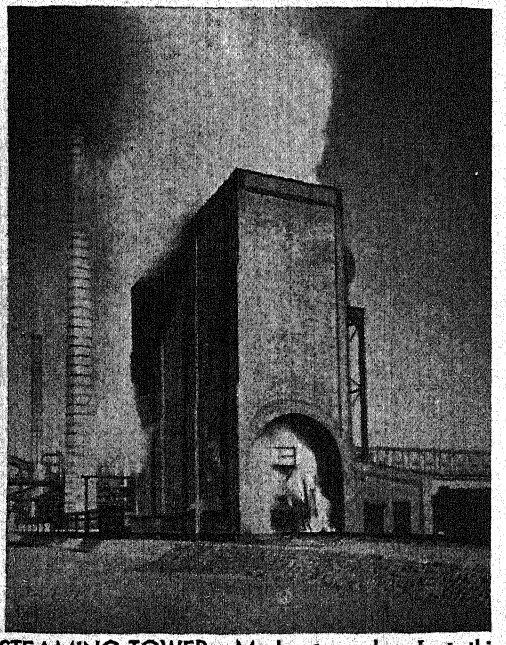
processes as heavy or light, in accordance with the magnitude and scope of the machinery and operations involved. Such a classification affects the type of equipment (particularly lighting) used and also the technical procedure. Characteristics of heavy



INDUSTRIAL DESIGN. Framing an outdoor industrial shot adds strength and power to composition design. The sidelighting here is excellent, giving texture and a dramatic quality to the silver towers against a dark sky. DATA: 3-1/4 x 4-1/4 camera, fast pan film, 1/100 second, f/16, K-2 filter

industry are large, ponderous machines handling heavy metal objects weighing tons. These machines, as in the paper and steel industries, may be over 100 feet long, and require a battery of *15 or 20 flashlights* and a wide-angle lens besides the equipment mentioned earlier. Though this equipment (which includes battery box, a couple of hundred feet of wire and reflectors on stands or clamp-on type) is perhaps beyond the reach of the amateur or even some professionals, the simpler equipment for use on smaller machinery should present no difficulty. Three or four large reflectors accommodating No. 4 photofloods will cover quite an area and should be flexible enough to take care of most lighting effects on small machines or details of them. This equipment is used when it is possible to stop a machine, pose the worker, and take a time exposure. Otherwise, it is necessary to use synchronized flash.

The illustration of the worker examining a propeller shaft is an example of close-up shots of a skilled worker. The picture (on page 2088) represents more than a large machine about which a number of persons hover. It portrays in the alert face of the man the years of painstaking experience and the high order of skill that are required in the production of a fine, intricate mechanism. Such a picture could easily be used in an ad to symbolize precision of workmanship or dependability of operation, etc. It would have particular force today in connection with the demand for skilled workers.



STEAMING TOWER. Made at a coke plant, this shot has much of the drama of industry. Cars full of coal at white heat temperature are moved under the tower and drenched with a stream of water. The upward surge of steam is so swift that the photographer must work at top speed to record the swirl. DATA: 3-1/4 x 4-1/4 camera, fast pan film, 1/200 second, f/11, K-2 filter
***Photo from* Fortune**

USE OF DISTORTION

There is, in my estimation, really only one type of distortion properly to be utilized by the industrial photographer. This type of distortion, either for dramatic effect or to product contrast of scale, permits a range of highly descriptive effects when used by the imaginative worker. The disparity in size and power between a machine which displaces 100,000 manpower and the single individual who operates it is psychologically so overwhelming that the photographer is tempted to express something of it. Simple distortion results. Unlimber your wide-angle lens, view your man at the end of a long row of gears and he becomes an inconsequential object by comparison.

The illustration of the continuous strip rolling mill, to be found on page 2089, illustrates the above point very clearly. The machine itself is composed of a number of units through which a massive steel slab at white heat is passed, the function of the last units being successively to exert greater pressure until the slab is converted into a thin sheet. A single worker stands at the controls of each unit and is responsible for gauging the pressure at his stage of the operation. Shooting down on the machine from an elevation, with the operator on the farther side, exaggerates the scale and expresses succinctly the vastness of the forces harnessed for productive purposes.

To get the atmosphere of the continuous strip rolling mill, the lighting problem involved is a variation of the one present at the open hearth furnace. Since the ingot in the process of rolling is heated to only a fraction of the temperature of molten steel, the light radiating from it will amount to very little

more than a dim flow. One must therefore be careful not to use an amount of light that will disturb the brightness range as the eye sees it. The danger of using full illumination is that the glow of the metal and its reflection on the polished metal rollers will be blotted out. An exposure of 1/50 second at f/5.6, using 2 or 3 bulbs, should be sufficient to allow the glow of the ingot to record itself. An open flash can also be used to give duration to the exposure.



TIDE WATER OIL REFINERY. A close-up angle shot has resulted in an arresting presentation of construction detail. The K-2 filter was used to darken the sky and allow for exposure for texture in the tanks. DATA: 1/25 second, f/22, K-2 filter

MORE SUGGESTIONS

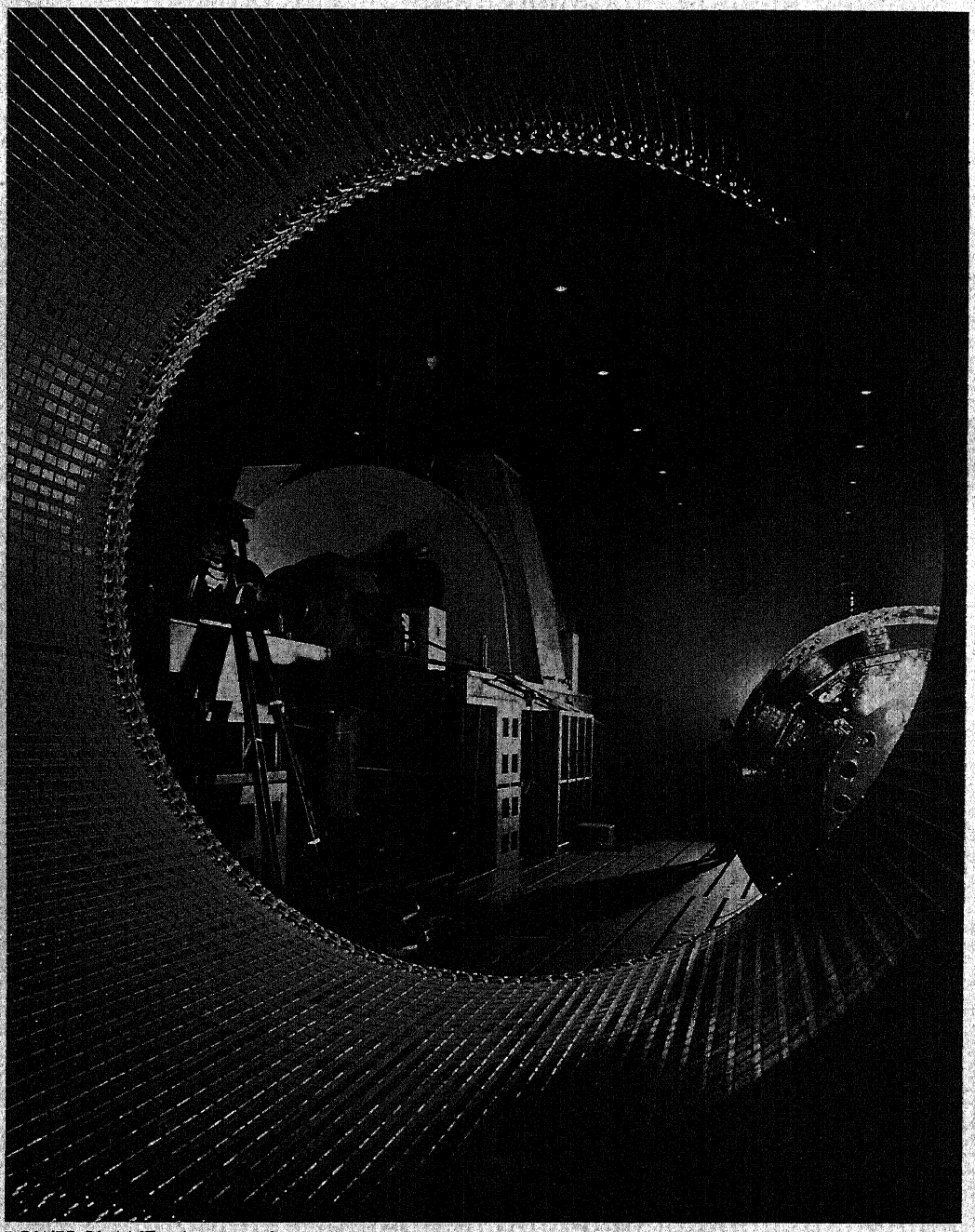
In addition to the material already given, there are a few general rules and suggestions.

The beginner in industrial photography will do well to confine his efforts to a *few* pictures, in covering a plant. He should become thoroughly acquainted with the machinery of the plant he is photographing and then conscientiously try to tell the story of that plant in as few pictures as possible. His pictures will gain significance this way. And he can concentrate more thoroughly on them. In preparing the original portfolio which I used in approaching *Fortune Magazine* for a job, I submitted only four interior pictures. The subject covered was a fairly simple one —the machinery of a laundry. But it took me one whole day of intensive work to make those four negatives. How could the pictures help but show that they were well planned and carefully executed? Care in execution will always pay dividends.

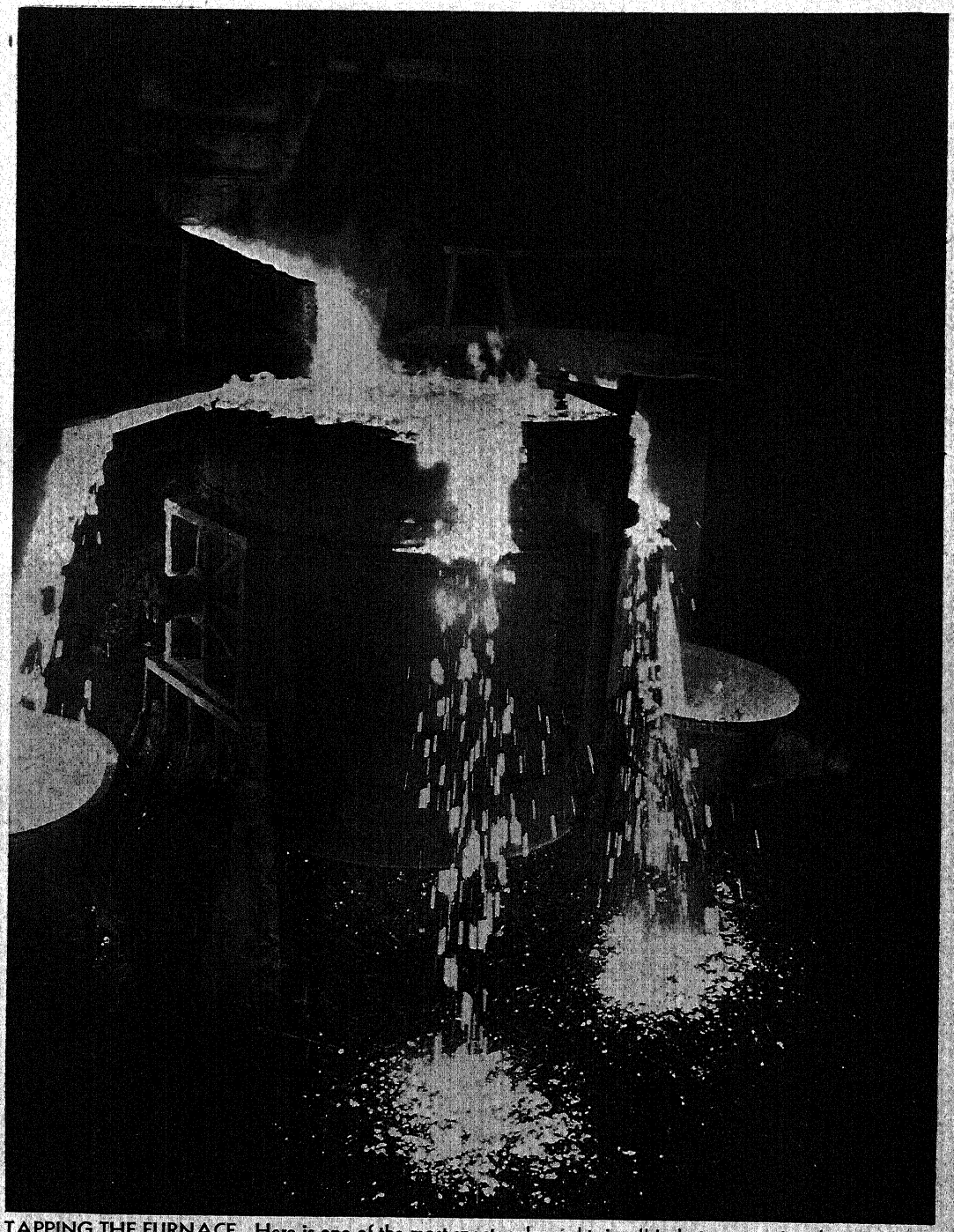
I would like to emphasize the need for pattern in industrial photography. It is in the pattern and design pictures that the photographer has his best chance to dramatize an industrial subject. I am always looking for patterns—in the coils and pipes of oil refineries, in the stacks and towers of steel mills, in the streaming rails of railyards, in the threads and strings and spools of textile plants. Particularly in photographing the small plants is it necessary to dramatize the subject. Big plants and massive machinery can be photographed "straight" much of the time (though even here a proper choice of viewpoint and lens will do much to accentuate the character of the machine); but in small plants the photographer must rely strongly on pattern shots.

The relation of men and machines is something that a photographer must constantly portray. I seldom make a picture of machinery without including a man or several men in the picture. There are two uses for these human figures in an industrial composition. In one case they are used to show the scale of the machine; in the other, men

are used to dramatize the machine by showing its grandeur or massiveness or by showing its own particular function. The placement of these human figures is an important part of the composition. In a picture of a factory interior in which the machines are to be shown as dominating the human element, the worker's figure should be placed at the



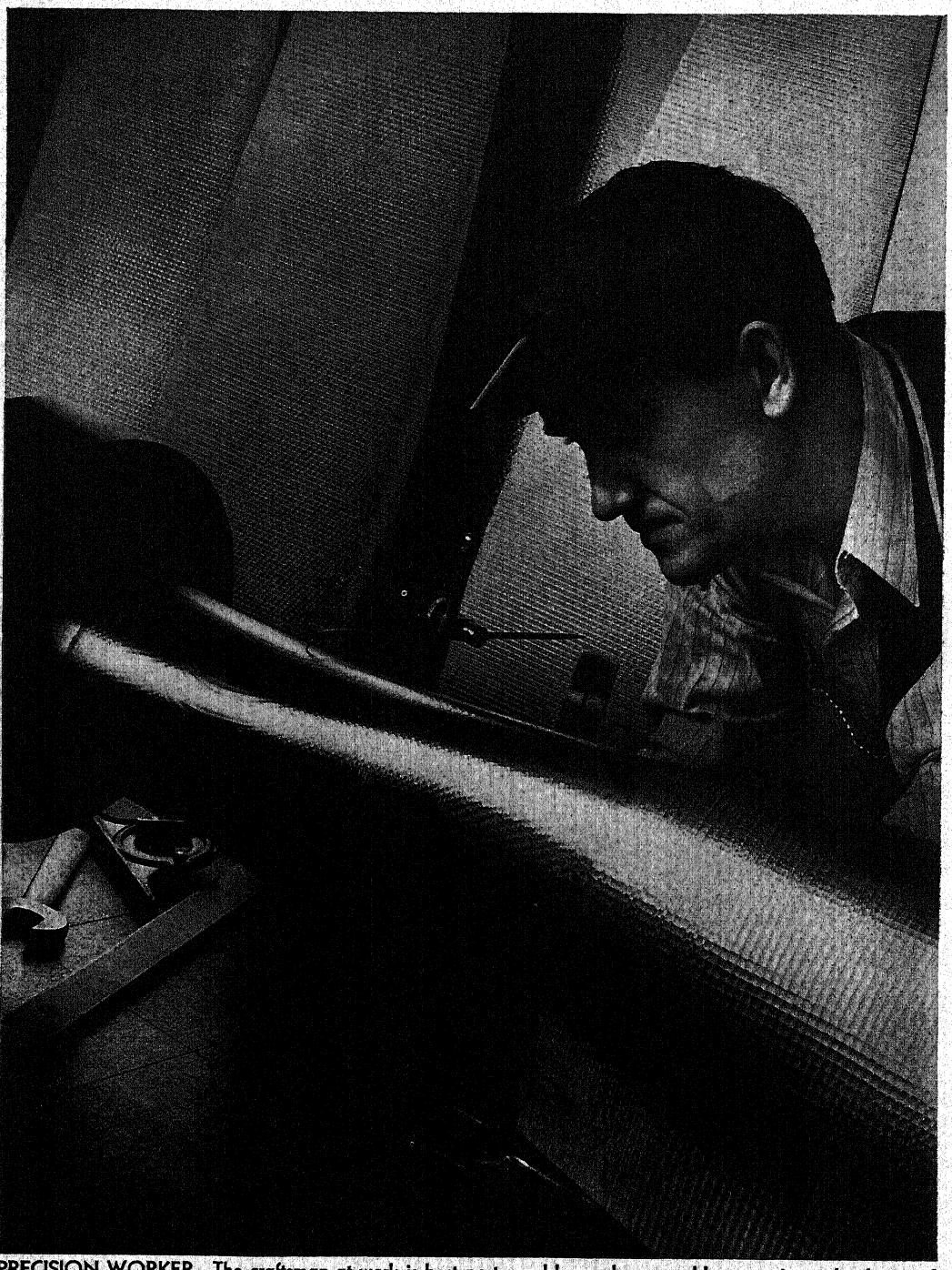
POWER PLANT. An example of effective framing and lighting. The photographer has succeeded in giving an impression of the drama of the work and has cut the subject matter down to a minimum by using foreground framing and a black background. Six flashbulbs were used, hidden from view by various machine parts, and a wide-angle lens made the foreground scope possible
***Photo from* Life**



TAPPING THE FURNACE. Here is one of the most spectacular sights in all industry—tapping the great open hearth furnace. Synchroflash equipment was used to balance the extreme brilliance of the molten metal—eight No. 2 bulbs about 15 feet away, with 5 at the right foreground and 3 at the left. DATA: 5 x 7 camera, fast pan film, 1/100 second, f/16, 8 flashbulbs, soft-working developer

far end of the composition so that he appears small and insignificant. In a case like this, a single human figure tells the story better than it would be told if several were used.

In a close-up shot intended to show the close relation of man and machine, the work-



PRECISION WORKER. The craftsman at work is best portrayed by a close-up. Here, against a background of propeller blades, a Pratt & Whitney worker concentrates on the precision testing of his work. The simple lighting was arranged for textural effects. DATA: 1/100 second, f/22, 1 flashbulb at left

man photographed should be chosen for his good face—the sense of seasoned craftsmanship which is the significant element in the relation of man and machine. Interest in the picture is increased by having the workman concentrate steadily on the work he is doing.



STRIP ROLLING—REPUBLIC STEEL. The magnitude and power of a roller machine is emphasized by an angle which dwarfs the small figure of the man who controls it and gives full prominence to the complex machine. In such a composition the whole spirit of modern machinery is captured. The problem of lighting was to bring out foreground detail and, at the same time, not overexpose the steel until it lost its reality. DATA: 3-1/4 x 4-1/4 camera, fast pan film, 1/50 second, f/11, 4 flashbulbs, open flash



AIRPLANE MOTOR PART. At the Pratt and Whitney plant, this detail shot was taken, showing a workman's hand and the patterns of the part he is handling. The size of the part is also clearly indicated by the comparison. DATA: 3-1/4 x 4-1/4 camera, 1/100 second, f/42, one No. 1 flash high on left, one No. 2 low on right
Photo from Fortune

He must look natural, not posed, and must concentrate exclusively on the delicate work that is involved in his relation to the machine.

Repeating a suggestion already made in this article, I would like to emphasize the importance of plain backgrounds in industrial photography. Absolutely the best way to secure this background, when faced with the problem of complete coverage of a large plant, is to climb to some height and shoot down, using the floor as background. Sometimes it is even necessary to have a scaffold built. This height eliminates one of the biggest problems of the industrial photographer —shooting against the light of windows.

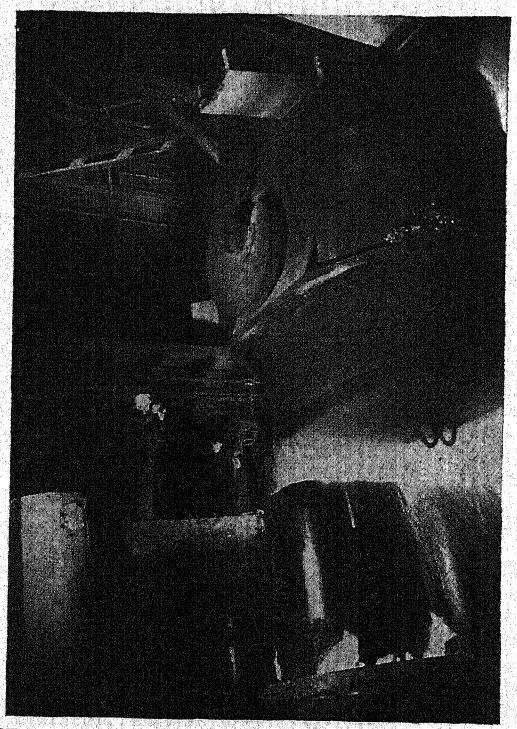
TECHNICAL QUALITIES OF NEGATIVES

There is a somewhat specialized problem involved in making negatives of interior industrial material. The contrasts involved in such shots as steel furnaces, etc. are so great that ordinary treatment of negative material is not sufficient to bring out proper detail. In all such cases I have found it best to overexpose slightly and underdevelop the negatives. This treatment softens the contrast and flattens the gradations.

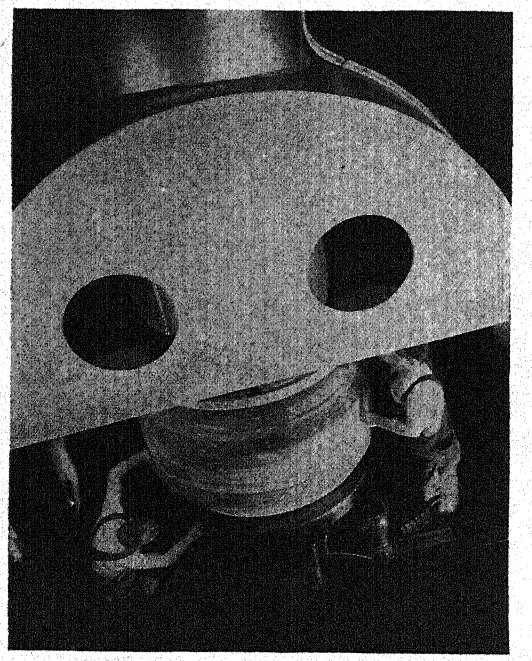
Naturally the quality of negative for industrial pictures must be as near perfect as possible. They should be razor-sharp. They should show the minutest of minor details. This is important.

EQUIPMENT

Equipment for industrial photography need not be very elaborate. A view camera, 9 x 12cm or 4 x 5, with swing movements should do very nicely. A sturdy and reasonably light tripod, an orange or red filter, light meter, a wide-angle lens—these are the essentials. A 2¼ x 2¼ miniature camera can be used quite successfully for exterior work. A groundglass camera such as the Rolleiflex is very satisfactory for composing.



STEEL LADLE. Lights were arranged to simulate actual lighting on the scene and to bring out details of the ladle and background. The figures of the men, though dominated by the huge mass of the ladle, are all-important as they represent the workmen who control the machines. A slow shutter speed was used in order to emphasize the path of sparks from the molten metal. DATA: 3-1/4 x 4-1/4 camera, fast pan film, 1/100 second, f/11



TIRE PRESS—FIRESTONE PLANT. The almost human quality of some machines is indicated in this striking picture of a high-powered tire press. The high angle emphasizes the feeling and makes the machine dominate the men who work at it. DATA: 3-1/4 x 4-1/4 camera, 1/100 second, f/16
***Photo from* Life**

Lighting equipment is more of a problem, involving quite a quantity of flash reflectors, wires, and battery box for multiple flash work. And for the handling of this and other equipment, an assistant will sometimes be necessary. Workers themselves should not be bothered.

In general I find it more convenient to work with filmpack. I use a fast film such as Tri-X.

The industrial photographer's equipment gets the toughest wear imaginable. It is necessary to have my camera, synchronizer, and meter tested after returning from each assignment I cover. One must have complete confidence in his equipment when working under the difficult conditions which industrial photographers constantly face. Still, the real essential of a photographer's equipment is imagination. The industrial photographer needs even more of that than other workers. With imagination, patience, and stamina he can make a success of a type of photography that offers a tremendously rich, varied experience.

INFRARED PHOTOGRAPHY

Walter Clark, Ph.D., F.R.P.S.

Kodak Research Laboratories; Author of Photography by Infrared

An authority on this comparatively new field of photography writes about infrared photography in daylight, artificial light, and in total darkness. Necessary equipment is discussed, as well as uses of infrared photography in aerial work . . . landscapes . . . criminology . . . medicine . . . scientific fields such as botany, astronomy, and industry.

See Also Aerial Haze, Infrared Photography, Flash

UNDER THE VERY BEST conditions, the eye cannot see light which has a wave length longer than that of the deep red. The limit is at about 7600A. Beyond this, however, is a wide gamut of radiations. Those which lie nearest to the visible red are known as the infrared, meaning "below the red." They merge into the heat rays and, at still longer wave lengths, these lead into the short and then into the long waves of radio. The short infrared radiation, lying nearest to the red, can be photographed on specially prepared films and plates. No materials are known, however, which respond to wave lengths beyond about 13,000A, and even the plates which can be used at this part of the spectrum are difficult to prepare and handle. On the other hand, the shorter infrared can be photographed with ease.

Infrared photography is not a new subject, for methods of making plates which respond to the infrared were known in the last century. They were only of interest to scientists, however, and it was not until 1931 that infrared photography became easily available for use in the normal manner. In this year it was discovered how to make infrared-sensitive materials which could be used with the ease of ordinary plates and films. The subject immediately began to grow in importance, and it has found increasing usefulness for amateur and commercial photography, cinematography, criminology and document photography, aerial and long distance photography, and for varied studies in the fields of science, technology, and medicine.

The discoveries which led to the new era in infrared photography were due to the dye chemist working in close cooperation with

those engaged in research on photographic emulsions. The dyes belong to the classes which the chemist knows as the cyanines. By use of appropriate dyes during the making of photographic emulsions, it is possible to prepare plates and films which will respond to the infrared out to about 13,000A. The materials sensitive to the longer wave lengths are of interest for scientific purposes, while those which permit photography of wave lengths from 7000 to 9000A are most used for general purposes.

USE OF INFRARED PHOTOGRAPHY

The infrared provides the general photographer with a means of obtaining new and interesting effects, and its applications in special fields are without limit. There is no essential difference between the practice of infrared photography and normal photography using visible light. Any photographer who is equipped for work with panchromatic plates and films can make infrared photographs at no additional expense other than that necessary to acquire the proper plates or films and a filter for use on the lens. The lamps generally used in photographic studios happen also to be the most suited for infrared photography. In handling infrared materials, some precautions are necessary which are slightly different from those required in common practice, but they present no difficulties.

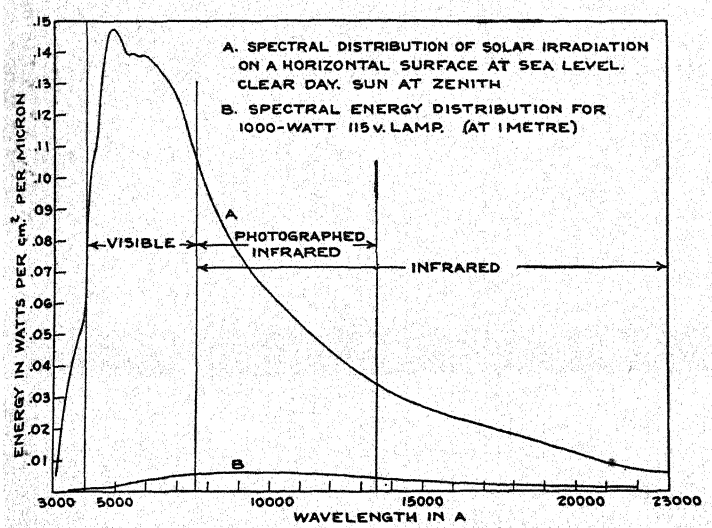
The value of photography by infrared lies in the fact that the radiations are very frequently reflected or allowed to pass by materials to an extent which may be quite different from the behavior of light which can be seen. Of particular interest is its ability to penetrate some materials much more readily than ordinary light so that details can often be revealed which cannot be seen in the common type of photograph. For instance, it can penetrate atmospheric haze, the green coloring matter of leaves, the skin and many dyes and pigments which appear dark to the eye.

SOURCES OF INFRARED

It has frequently been stated that infrared photography requires the use of special kinds of radiators, such as those which might be used for therapeutical purposes. This, however, is quite wrong, for sunlight and the normal types of studio lamp are the best.

The sun is a very satisfactory source of infrared. Obviously it cannot be very conveniently used in a studio, but it is the natural source for outdoor photography. The intensity of infrared in sunlight varies somewhat in the same way as the intensity of visible sunlight, but there is no strict relationship between the two, a fact which makes ordinary exposure meters unreliable for estimating infrared exposures outdoors.

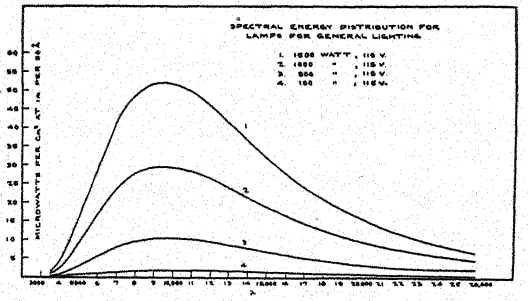
All sources of light which depend on incandescence for their operation emit a high proportion of infrared. Sunlight is such a source, while others are tungsten filament electric lamps, arcs, oil lamps, gas burners, and candles. These differ in efficiency and it is only the tungsten filament lamps, the arcs, and flash lamps which are useful in practice. The modern gas-filled coiled-filament electric lamp is very satisfactory and much more efficient than the older types of vacuum lamp. Those in common use are studio lamps, 500-watt projector lamps and the overvolted



Graph showing the spectral distribution of radiation from sunlight and a tungsten filament electric light. Wave length is given in Ångström units

lamps of the photoflood type. These lamps emit the maximum of radiation in the region of the spectrum to which the fastest infrared films and plates respond.

The carbon arcs are very satisfactory for infrared photography and certain of them



Graph showing the spectral distribution of radiation for tungsten filament electric lamps for general lighting

have the cores of the carbon so prepared as to have a specially high emission in the infrared. Carbons of the following types are suitable: National Carbon Co., Sunshine and Motion Picture Studio carbons; White Flame arc carbons; Low Intensity Projector arc carbons; Suprex positive carbons; High Intensity Projector carbons; High Intensity Sun Arc carbons.

The photoflash lamp is an extremely good source of infrared radiation and very convenient in use.

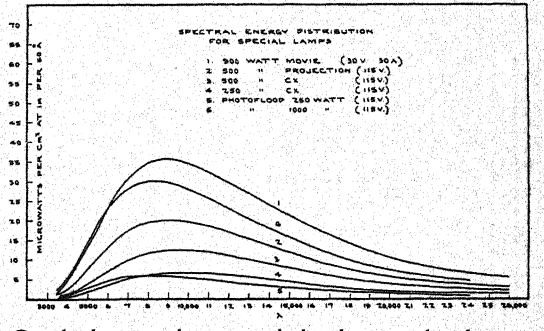
FILTERS

It is always necessary to use a filter in making infrared photographs. In common with other types of plates and films, all infrared materials respond to red and blue light. In order to confine the exposures to the infrared, therefore, it is necessary to use a filter which cuts out the violet and blue. This means that the filter should be at least deep yellow in color, but in practice it is best to use a red filter. Some infrared plates and films have sensitivity in the visible red and when they are used, if it is desired to confine the exposure to the invisible infrared, very deep red or opaque filters must be used. Many of the special effects of infrared photography can be obtained even if some red light is present, and filters similar to the Wratten No. 15, No. 25, or No. 29 will be entirely satisfactory. The filter in most common use for general infrared work is the Wratten No. 25. If the picture is to be made entirely by infrared, the deeper filters such as the Wratten No. 70, No. 89, or No. 87 should be used. The choice of filter will naturally be determined by the nature of the photography and the response of the plate or film.

The exposures through all filters will be the same for a particular material provided they do not absorb an appreciable amount of infrared. It is not customary to give filter factors for infrared plates and films since they are not commonly used without a filter, and a figure giving the number of times the exposure must be increased when a filter is used would have little significance. In their exposure guides, manufacturers usually merely denote the time of exposure required for a certain subject under definite conditions when used with a particular filter.

CAMERA EQUIPMENT

Most modern cameras are well suited for infrared photography. There are, however, certain precautions which should be observed, particularly if old equipment is used. The fact that it is not possible to see through a black material does not indicate that the



Graph showing the spectral distribution of radiation for tungsten filament lamps for special purposes

infrared will not pass through it. In fact, some kinds of black, hard rubber and wood are very transparent to infrared. Photographs have actually been taken through hard rubber draw slides while they were still in position in the holders in the camera. In some of the older cameras the bellows, shutter blades, and dark slides are not entirely opaque to the infrared, and if they are used the plate or film may be fogged. If fogging occurs, and particularly if the edges of the

plate or film covered by the rebate of the holder are clear, tests should be made to check whether the bellows, shutter blades, or dark slides are unsafe. Bellows used on most modern cameras are quite satisfactory, especially if made of leather or artificial leather containing carbon pigment and backed by black cloth. Some types of hard rubber used for shutter blades and draw slides are quite safe and, in fact, some manufacturers test the hard rubber of their dark slides to make sure that they are opaque to infrared. Those made by Eastman Kodak and Folmer Graflex carry five dots embossed on the metal tops if they have been tested and found safe in the infrared. Wood should be avoided. Metal is perfectly safe.

Lenses. Most lenses made for photography with panchromatic materials are so designed that they have the same focus for violet and yellow light. Other colors are not quite in the same focus, but it is found that if the violet and yellow are equalized, the lens gives quite satisfactory results for white light and present-day types of plates and films. The focus changes rapidly as the wave lengths increase into the infrared, so that it is frequently necessary to correct for focus if sharp pictures are to be obtained.

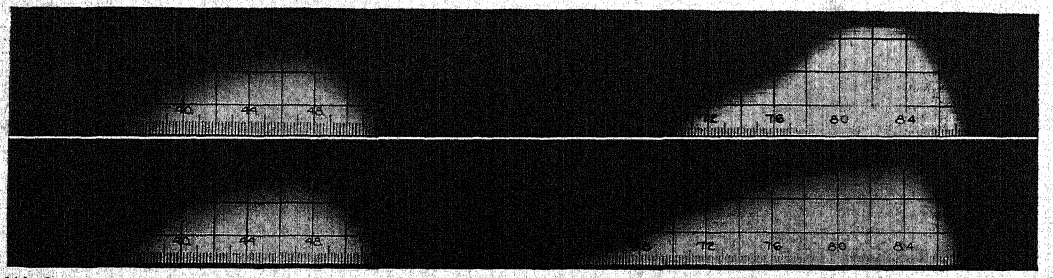
Lenses vary considerably in the amount of correction of focus necessary. A few lenses are actually made to give sharp focus in the infrared when they are focused visually on the groundglass. Lenses of moderate aperture on small cameras can usually be used for infrared photography without adjustment. It is not possible to make general statements about the correction for focus because lenses differ markedly. In all cases where a correction is required, however, the lens must be racked out for a distance slightly longer than that necessary for good focus with a panchromatic film. This is equivalent to focusing on a nearer object. Some manufacturers place a special mark on the focusing mount for infrared work. If there is doubt about the required correction, the lens should be calibrated by making a series of photographs at slightly different settings, starting with the position of correct panchromatic focus. The scale position corresponding to the sharpest negative of the series can be marked to indicate the correction necessary in the future. Help is sometimes obtained if the picture is focused with a red filter on the lens, but this naturally only applies to cameras with a focusing screen. The pictures are always sharper if the lens is stopped down and so, if possible, it is an advantage to use small apertures and correspondingly long exposures.

Plates and Films. Many plates and films are sensitive to different portions of the infrared. For general use, it is only those sensitive between 7000 and 9000A which are of interest. They are available in several forms as plates for general photography and process work, films for miniature and roll film cameras, motion picture work and aerial photography, and as cut-sheet film.

PRACTICE OF INFRARED PHOTOGRAPHY

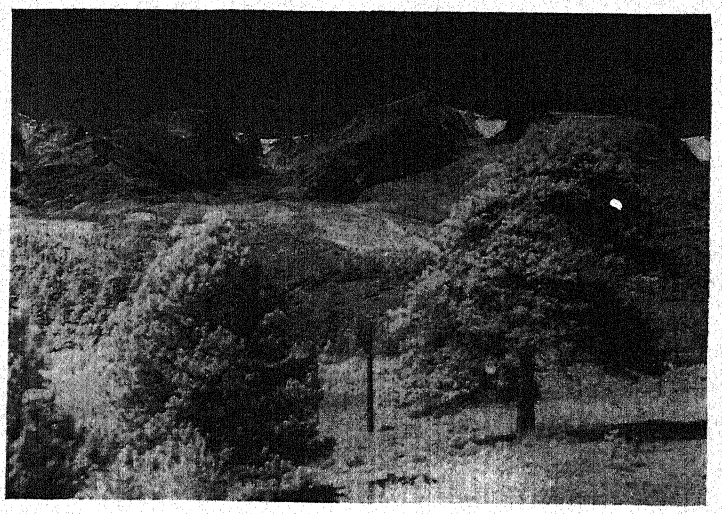
The various applications of infrared photography will be dealt with later in this article. It is convenient at this stage, however, to discuss briefly the actual methods of making exposures in the three main types of infrared photography: landscape photography, photography indoors by artificial light, and pictures in total darkness.

Landscapes. The exposure for landscapes will naturally depend upon the conditions,



Wedge spectrograms showing the wave lengths to which different classes of infrared materials respond. These are for the two common types. Other classes are sensitive in different spectral regions out to 13,000Å. Above is Eastman Infrared Process plate, below is Eastman Infrared-sensitive plate

but infrared pictures are rarely made out of doors unless the sun is shining. In summer sunlight for average scenes and a Wratten No. 25 or No. 29 filter on the lens, the exposure is approximately 1/25 or 1/50 second at f/5.6 or its equivalent on the various Eastman infrared sensitive plates and films. If the deepest filters, such as the Wratten No. 89 or No. 87 are used, the exposure will be double that mentioned, i.e. 1/25 or 1/50 second at f/4 or its equivalent. Exposure meters are not entirely reliable for infrared exposures in daylight, since daylight varies in the ratio of visible to infrared radiation. The manufacturer's exposure guides should preferably be used. In infrared photography from the air, the exposure will be somewhat shorter than from the ground. On the various Eastman materials using the Wratten No. 25 filter, it will be 1/50 or 1/100 second at f/5.6 on a clear day. Specially fast films are made for use in aerial cameras. If it happens that infrared landscape photographs must be made on a dull day, the increase in exposure is about double the increase which would be required for panchromatic plates and films.



Infrared telephoto shot made in Estes Park, Colorado

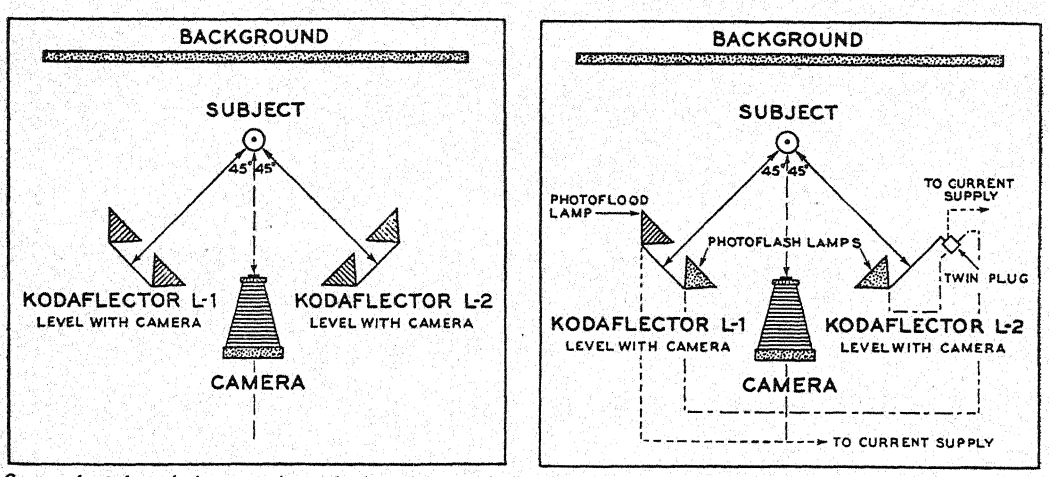
Indoor Pictures. Infrared photographs by artificial light will usually be made by regular studio lamps, photoflood lamps, lamps of the photoflash type, or even tungsten filament lamps of high wattage. Unless the pictures are to be taken in total darkness, a filter such as the Wratten No. 25 should be used on the lens. For infrared portraits, the lighting should be rather flat because it is rarely required to produce modeling in the subject, but merely differences in reflection and transmission of the skin. The photographer will not in general be interested in infrared portraits, for the results are definitely not flattering. The flesh appears translucent, red lips come out light, and the eyes appear very black. Portraits in the studio, however, are often required for medical purposes and the arrangements used for them will apply also to the photography of inanimate objects and the copying of documents and other subjects.

A typical arrangement of the lamps is shown in the accompanying illustration on page 2096. Two pairs of photoflood lamps or 500-watt projector lamps are used in reflectors arranged symmetrical to the subject at 45°. If a single photoflash lamp is employed it should be placed as near the camera axis as possible. Better results are obtained by using two photoflash lamps fired simultaneously by an appropriate switch, as also illustrated. A single photoflood or lamp is used for focusing and composition (see *Infrared Flash Photography*).

The following table shows the exposures required for Eastman Infra-Red Safety Film, Eastman Infra-Red Sensitive Plates, and Kodak Infra-Red Film available in 1941,

	Four No. 1 Photofloods* in Kodaflectors		Two No. 11 Photoflash Lamps in Kodaflector
Distance lamps to subject	*Aperture*	*Time*	*Aperture*
3 ft.	f/11	½ sec.	f/22
	f/22	2 sec.	
5 ft.	f/8	½ sec.	f/16
	f/22	4 sec.	

*Two No. 2 photofloods may be used in place of 4 No. 1 photofloods.



Set-ups for infrared photography with photoflood and photoflash lamps. Left is a diagram for photoflood lamps; right is the set-up with two photoflash lamps and a photoflood used for focusing

used with the Wratten No. 15, No. 25 or No. 29 filter *

In the case of unusual subject matter or uncertain light conditions it is advisable to make a series of exposures. First, give the exposure corresponding to the best estimate. Then, give four times (two stops) more, and last, give four times less exposure than the first. One of these usually will be satisfactory.

In photographing small subjects where the camera bellows is considerably extended, the effective aperture is considerably less than that marked on the lens. The same rule applies as for normal photography, but it is perhaps as well to draw attention to it here. At one-to-one magnification the effective aperture is numerically twice the rated value. For example, if the diaphragm is stopped down to f/8, the actual working aperture is really f/16, and four times the exposure will be required. No allowance need be made for objects more than three or four feet away. The effective f-value for all close-up work can be computed from the formula:

$$\text{Effective f-value} = \frac{\text{Indicated f-value} \times \text{lens-to-film distance}}{\text{focal length}}$$

The lens-to-film distance is the focal length plus the lens extension from its position for infinity focus.

It is possible to use the normal exposure meter for infrared photography by artificial light. Under definite operating conditions the ratio of infrared to visible light from a lamp is constant. If, therefore, the visible light is measured by an exposure meter, the corresponding infrared exposure can be calculated by applying a factor. The meter should be calibrated by a trial under the particular working conditions.

Photographs in Total Darkness. Since the infrared is invisible, photographs can be made in total darkness. This does not mean, however, that they can be made in complete absence of radiation. Tungsten filament lamps such as studio lamps or photoflood lamps and sources of the photoflash type must be used. In order to exclude all visible light and to be sure that the photograph is taken only by invisible infrared, the lamps must be used in light-tight reflectors or lamphouses and screened with a filter which absorbs visible light but transmits the infrared freely. The Wratten No. 87 filter is especially made for this purpose in sizes 8 x 10 inches and 10 x 12 inches in the same form as safelights. A convenient arrangement is to use two pyramid safelight lamps each fitted with one No. 1 photoflood lamp and two thicknesses of Wratten No. 87 filter. The inside of the lamphouses should be lined with tinfoil.

(*Continued on page 2097*)

* If the Wratten No. 70, No. 89, No. 88, or No. 87 filter is used, give double the exposure. The No. 87 filter is to be preferred for document and clinical photography.

INFRARED PHOTOGRAPHY
(Continued)

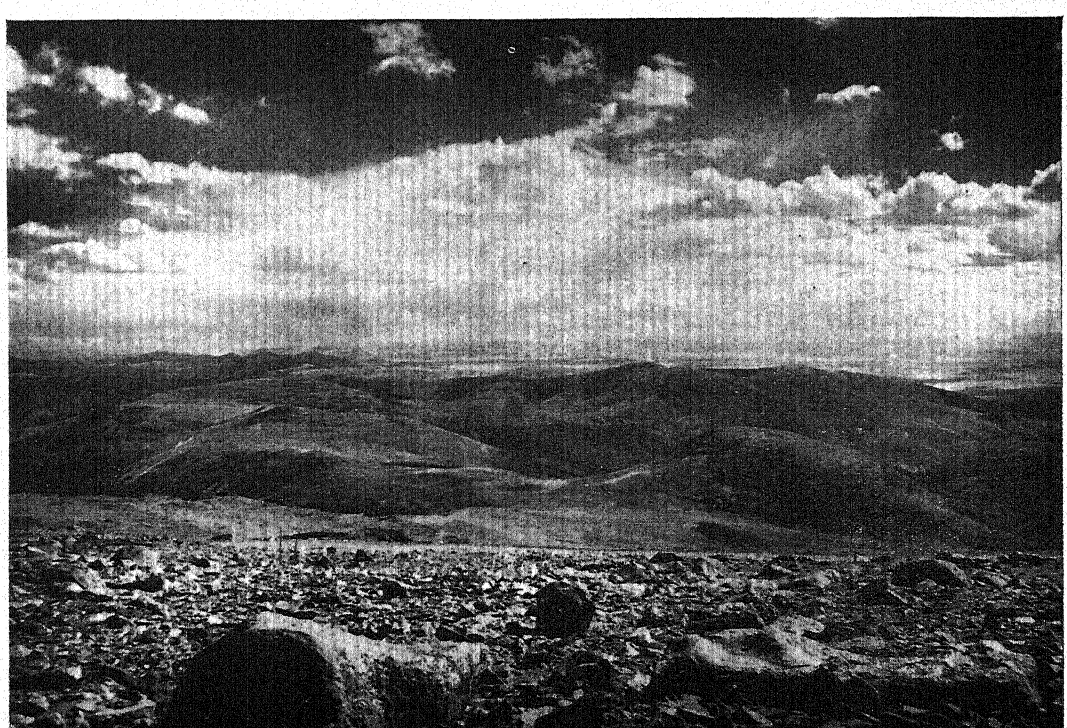
With these units three feet from the subject, an exposure of about one second at f/4.5 is required. It is possible that the subject will see the filaments of the lamps as a deep red glow if he looks straight toward them. If, however, the lamps are pointed towards the ceiling so that the illumination is indirect, the effect of complete darkness is achieved.

Darkroom Operation. Infrared sensitive plates and films are developed and fixed in the same manner as the materials for general photography. The recommendations of the manufacturer should preferably be used. The materials should be handled in total darkness or by the aid of a Wratten Series 7 Safelight used with a 10-watt lamp at a distance of not less than 3 feet. Other safelights cannot be used, since they all transmit the infrared.

LONG DISTANCE PICTURES

The most common use of infrared photography is in making long distance pictures from the ground or air. Its value in this connection lies in the ability of the infrared to penetrate atmospheric haze. This means that the details of distant objects can often be revealed under conditions in which they would not be visible to the eye or appear in the normal photograph. Haze consists of minute particles of dust, smoke, and water vapor suspended in the air. These particles are able to scatter light in a manner which depends on their size. The particles must be smaller than the wave lengths which they will scatter preferentially. Atmospheric haze, which is normally bluish in color, scatters the shorter wave lengths of visible light allowing only the longer wave lengths to pass. The haze appears to impose a bluish veil between the observer and distant objects. If a photograph is taken by light which is transmitted by the haze while the scattered light is absorbed by a filter, the haze can be penetrated.

The best penetration is achieved by the use of infrared-sensitive plates and films and a filter which confines the exposure to the

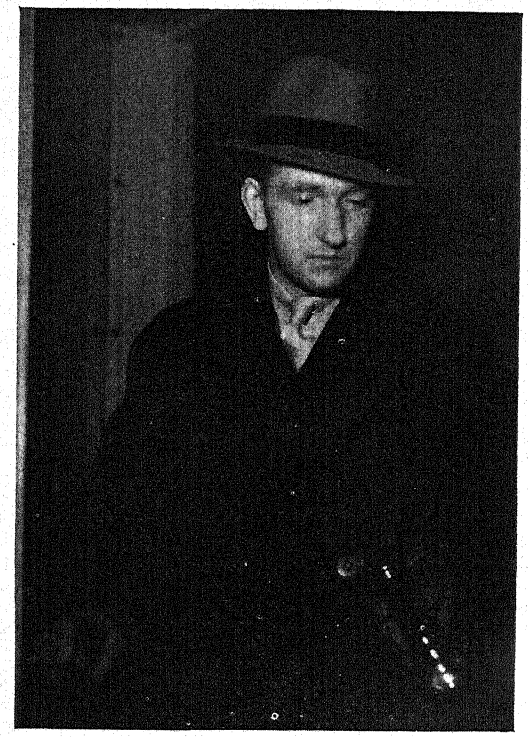


Infrared photograph taken from Mt. Evans, Colorado

infrared. It should be realized that *photographs cannot be made through fog or mist* where the particles are large and the appearance is grayish. It is a safe rule to assume that where visibility is low, it is not possible to increase it appreciably by use of infrared. Infrared photography is, however, of very great value in penetrating distant haze and for this purpose it is used in photographic mapping, aerial reconnaissance, and other cases where good rendering of distant detail is desired.

LANDSCAPES

Infrared landscape photographs have unusual characteristics. The sky appears black, clouds and snow are very white, shadows are dense and lack detail, distant details are rendered with great clarity, and grass and leaves appear very light as if covered with snow. This last effect is due to the fact that chlorophyll, which imparts the green color, is very transparent to the near infrared which can pass through it and be reflected out again by the tissues of the leaves. In general, the leaves of deciduous trees appear very white, those of coniferous trees appear darker, and dead trees can also be distinguished by their darker rendering. For this reason, infrared photography is of interest to the forest surveyor. Photographs taken outdoors in sunlight by infrared have a quality which resembles that of photographs taken by moonlight. Many night scenes in professional motion pictures are actually taken in sunlight using infrared film. This

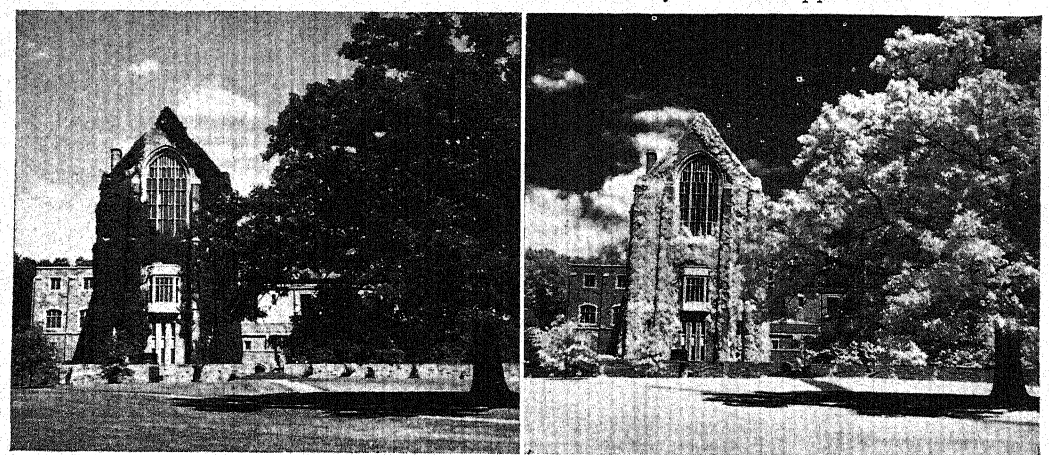


Photograph of an intruder taken in total darkness by infrared radiation from photoflash lamps. See article on *Infrared Photography With Flash*

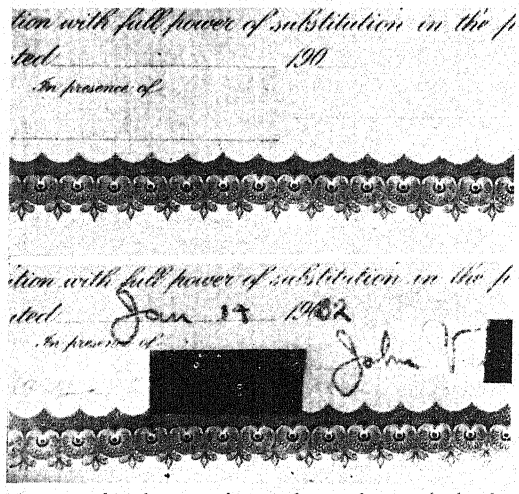
was, in fact, one of the earliest commercial uses of infrared photography. Striking architectural photographs may be made by infrared and it has proved of some use in geological survey.

CRIMINOLOGY

In criminology infrared photography has found many valuable applications. Some of



A normal outdoor subject was photographed (left) on panchromatic film and then (right) on infrared film. Notice the white foliage and grass, black sky, and outstanding clouds in the second photograph



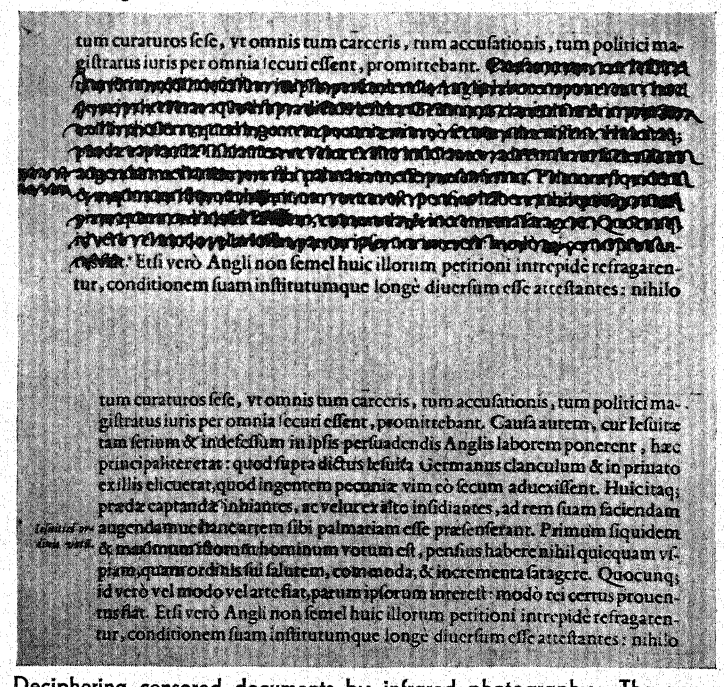
Photograph of a stock certificate from which the writing had been chemically eradicated. At the top is a normal photograph showing the certificate as it appeared to the eye. At the bottom is the same subject taken by infrared—revealing dates and signatures. The black patches are placed over the signatures because they are those of living persons
Photo, L. Waters

the more interesting are: detection and deciphering of erasures and forgery; deciphering of charred documents and those which have become illegible as the result of age or wear; differentiation between inks, dyes, and pigments which may appear identical to the eye; distinguishing between cloths which look identical but which are dyed with different dyes; detection of stains and irregularities in cloth; examination of cloth, fibers, and hair which are dyed too darkly to be easy to study by visible light; examination of fingerprints; study of the contents of sealed envelopes and of certain kinds of secret writing; detection of blood stains on cloth; photography in the dark. All these applications rely on the fact that the reflection and transmission of infrared by materials is frequently very different from their normal reaction and behavior to visible light.

Some of the most interesting uses of infrared photography have been in the examination of documents. The most striking of these is in the detection of writing which has been deleted by a censor by over-writing with another ink. If the over-writing is transparent to the infrared and the original ink is opaque to it, infrared photography can see through the second writing and reveal the first. Infrared photographs of charred documents have frequently allowed the writing to be deciphered, although success in these cases is dependent upon the degree of charring. It has actually been possible to show up fingerprints which were present on a piece of paper before it was charred by fire. Writing which has been mechanically erased may be revealed by virtue of traces of carbon or other pigment left embedded in the paper fibers, and chemically bleached writing may frequently be deciphered by infrared (see *Investigation of Documents by Photography*).

MEDICAL FIELD

In the medical field, infrared photography shows promise of being a useful means of



Deciphering censored documents by infrared photography. The upper photograph shows a Latin document as it appeared to the eye, while the lower one shows the same subject as photographed by infrared
Photo, Dr. L. Bendikson

diagnosis. The infrared can frequently penetrate the skin and other superficial layers of the body and reveal the subcutaneous veins under the skin, some of which are not discernible visually or in ordinary photographs. Changes from the normal venous pattern have been recorded in connection with axillary thrombosis, cirrhosis, and some tumors which show a marked disturbance of the adjacent venous circulation. Changes in the superficial venous pattern in the chest and abdomen during pregnancy can be shown distinctly. Infrared photography has been used with success in the study of skin diseases and of the eye. It is of value in the examination of gross specimens, particularly in the case of injected specimens for checking the completeness of the injection without clearing. Infrared photomicrographs of deeply pigmented tissues and relatively thick histological specimens frequently show details which are not discernible in photographs made by visible light (see *Medical Photography*).

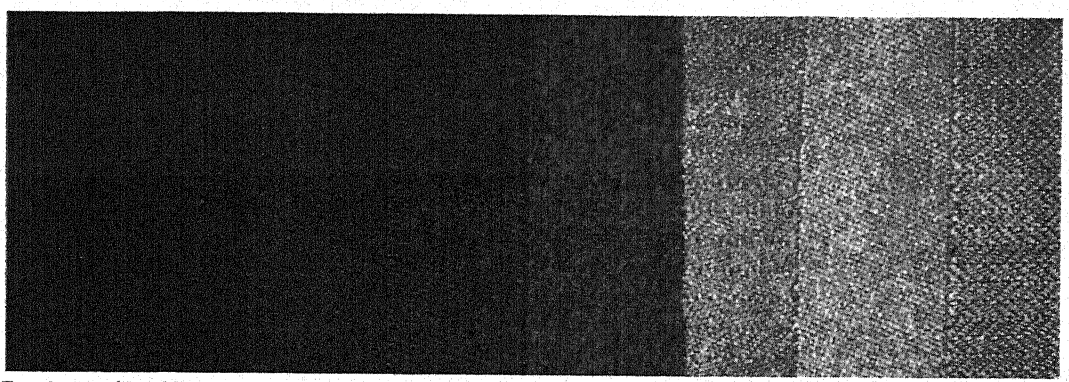
SCIENTIFIC FIELDS

There have been many applications of infrared photography in technical and scientific fields and they are steadily increasing in number as the possibilities become realized. Photographs of hot objects may be made in total darkness by the infrared radiation which they emit and a sort of photographic thermometry has been worked out in which it is possible to obtain an idea of the distribution of temperature over heated materials such as electric hot plates, hot metal ingots, radio tubes, and cylinder heads and exhaust manifolds of internal combustion engines.

In plant pathology, infrared photography has provided a valuable means of studying and diagnosing plant diseases in which there is change in the pigment or cellular material. Different kinds of wood show marked variation in their transparency to the infrared and photographs have shown that the infrared may be of much value in coal petrology and other fields of paleobotany. The textile industry has applied infrared photography to the detection of irregularities in the dyeing and weaving of cloth and in damage to the fibers. If the material is dyed dark, it is frequently difficult to detect these irregularities visually, but if the dyes are more or less transparent to the infrared, photography makes the task easy. Even in the graphic arts industry infrared plates have been



Photograph of a lily on panchromatic film (left) and on infrared film (right)



Textiles analyzed by infrared, to find faults in dyeing or fibers. Shown are strips of black cloth of different types which, though appearing uniform to the eye, show distinct differences as revealed by infrared

used, especially to differentiate between light and dark blues in multicolor printing, and in preparing the negative of the black printing plate from originals prepared in specially selected colors. Other applications include study of the interiors of furnaces while operating, detection of carbonaceous matter in lubricating oils, and the porosity of tin plate.

Infrared photography has proved of enormous value in astronomy and spectography. Large numbers of new stars have been discovered by its aid, photographs have been made through the haze of nebulae, and it has aided in the study of the atmospheres of the planets.

Infrared photography is an important adjunct to chemical study and X-ray and ultraviolet photography in determining the authenticity of paintings. Pigments vary in the way in which they transmit and reflect the infrared even though they may appear identical in color. Infrared photography, therefore, can sometimes be of use in detecting the presence of over-painting and other alterations and in distinguishing between an original and a copy. The infrared can often reveal detail through varnish which has deteriorated. Photographs, daguerreotypes, engravings, drawings, maps, and other such documents which have become badly discolored or faded by age have been successfully photographed by infrared.

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INFRARED PHOTOGRAPHY WITH FLASH

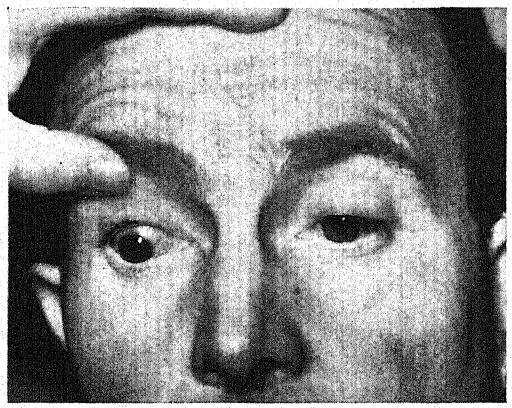
Jacob Deschin

Camera Editor, The New York Times *and* Scientific American; *Author of* New Ways in Photography, Finding New Subjects For Your Camera, *and others*

Blackout photography is something new in the camera world—a way of exposing an infrared-sensitive emulsion by the invisible flash of infrared radiations. Exposure and the technic of taking pictures in the dark are covered here —along with uses and precautions.

See also Flash Photography, Infrared Photography, Ultraviolet Photography

NEW YORK PRESS photographers had their first real try with "blackout" flash when midtown Manhattan staged its first test blackout so successfully that had it not been for the bright full moon you could not have seen your hand before your face. The printed results were startling to laymen who had never seen the like before. The most painstakingly applied lipstick and rouge vanished under the magic rays of the infrared bulb, substituting a ghastly pallor for even the healthiest complexion. Men who had shaved just two or three hours before apparently had spent their efforts for nought because they appeared to be sadly in need of another



This shows a new application of infrared flash photography—clinical photography by eye specialists, ophthalmologists, etc. Where regular flash would be painful to a patient's eyes, the blackout bulb will not disturb the patient at all. DATA: 4 x 5 view camera, infrared sheet film, open flash, f/36, 1 Blackout Superflash at 4 feet

one. Veins lying just under the skin were revealed as black lines.

Unnatural, eerie, slightly frightening, the strange effects were due to the peculiar nature of the medium, intended strictly for emergency use and promising nothing more than a better-than-no-picture convenience when "invisibility" of the flash is the first consideration. If tone values are falsified in the process, well, that's because you can't eat your cake and have it, too—not yet anyway. Up to the present writing, the film manufacturers have been unable to introduce anything like normal panchromatism into the infrared emulsion which, as matters now stand, has a sensitivity, when used with black flash, almost entirely to the red end of the spectrum.

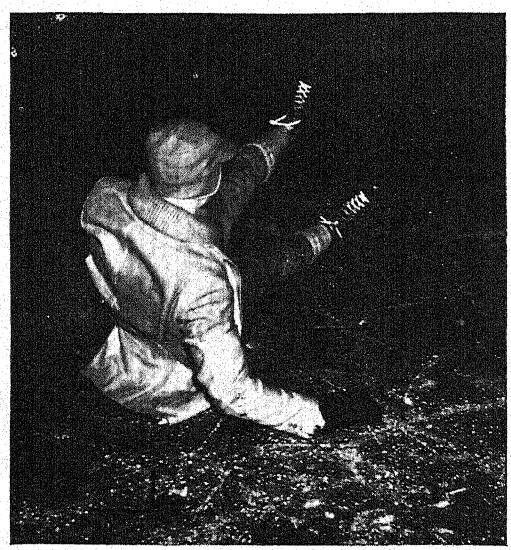
THE BULB

The infrared effect is the result of combining infrared film and a light source suitably filtered to provide infrared (also known as black* or invisible) illumination. This filtering is achieved by placing over the reflector a screen such as Wratten 87 or 89, by using a filter over the lens (as in daylight infrared work), or by coating the bulb itself. The second method is obviously useless for our purpose because it is of the utmost importance that neither the subject nor the light be seen during the exposure. The first method is inconvenient because this would require removal of the screen each time it was necessary to replace a bulb. The only practical method, therefore, is to coat the bulb itself, in effect providing a separate filter for each bulb. An expensive procedure, to be sure, but at the same time the only logical solution.

So that's the way it was done, first by the Wabash Photolamp Corporation, who introduced the Blackout Superflash, and later by Westinghouse and General Electric, who followed with the No. 22-R and the No. 5-R. The filter jacket, designed to absorb practically all of the visible light produced inside the bulb, is applied by dipping the bulb in a dye-lacquer solution which dries hard and tight over the entire surface of the bulb. The light transmitted thereafter is almost entirely in the infrared region.

INFRARED FILM

Infrared film is supplied in roll film by Eastman, Agfa, and DuPont, the latter only in 35mm rolls. Eastman's infrared cut-sheet film is the most extensively used in connection with blackout flash, however. Of this there are two types, the regular, which has a



A candid photograph in the total darkness was made possible by infrared flash. DATA: 4 x 5 Speed Graphic, 13.5cm Zeiss lens, Mendelsohn Speedgun, Aero-type infrared film, 1/200 second, f/5.6, 1 blackout bulb at 10 feet
Westinghouse photo, Harold Siegman

*Ultraviolet light—especially when used in connection with fluorescent display materials—is also known as "black light." See article on *Ultraviolet Photography.*



Dan Grossi of Wabash is shown with his infrared equipment. He has a Speed Graphic with Sun Ray Infrared Flash Reflector. Note the clip-on visor recommended by Army officials to prevent undesirable visibility from the sky

Weston speed of 4, and the special Aero Emulsion No. 2, available on special order in 4 x 5 size only. Previously employed in aerial infrared photography only, its usefulness in blackout work was discovered by Dan Grossi, of Wabash, by a fortunate accident. It is much faster than the regular infrared and was therefore hailed by newspapermen as the solution to one of the great drawbacks in blackout flash work, namely the slowness of the regular infrared film and the consequent necessity of using large stops.

The Aero film is coated on a thin base, which makes it a little difficult to handle in the darkroom because of its tendency to curl. Placed in a negative envelope between two weights or inside a book, it will keep flat when not being used. Users are warned by the manufacturers that the film remains effective only for 60 days and then only if stored in a refrigerator. However, experience has shown that the film will last as long as 6 to 8 months in a refrigerator cooled to 30° or 40°F. and about four months without refrigeration.

EXPOSURE

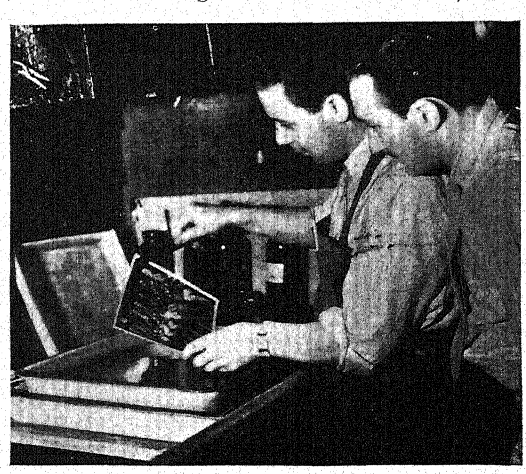
At first thought to be as much as ten times faster than the regular type but now known to be three to four times faster, the Aero film is exposed, according to Wabash, as follows:

AERO FILM EXPOSURE

f/11 —1/50—10 feet
f/8 —1/50—15 feet
f/5.6—1/25—25 feet
f/4.5—open—up to 40 feet

These figures are borne out in experiments conducted by Alan Fisher, *PM* photographer and one of our outstanding practical experts in flash work, who feels, however, that good negatives cannot be obtained at distances greater than 25 feet. He reports, also, that he was able to note no appreciable difference in negative density between exposures made at 1/50 second and those with open flash.

Mr. Fisher further differs with regard to development procedure recommended for black-flashed infrared film. Wabash suggests developing the film 25 percent longer than normally indicated, but Mr. Fisher finds that if he develops the film normally, that is—3½ minutes at 73°F. in DK60a, the same as for Super Panchro Press Type B—he gets just about the right density and contrast for satisfactory prints on No. 2 or No. 3 paper. After extensive trials, he found that overdevelopment did not produce any more of an image than did normal development but that he did get more contrast and, with



Except for an enclosed ruby safelight, a Blackout Superflash was the sole light for this darkroom shot. DATA: 1 Blackout Superflash 6 feet from camera, 1/50 second, f/5.6



An infrared flash "pictorial." Here is an appealing shot taken in the total darkness. Notice the slight color distortion in the nurse's face, due to lack of blackout make-up. DATA: Speed Graphic, infrared film, 1/10 second, f/5.6, 1 Blackout Superflash at 7 feet
Photo for Muskegon Chronicle, William A. May

three times normal development, a practically unprintable image.

Exposures with the regular Eastman Infrared film call for larger stops or closer working distances. Wabash offers the following table:

EASTMAN INFRARED FILM
EXPOSURE
f/5.6—1/50—10 feet
f/4.5—1/50—15 feet
f/3.5—1/100—15 feet

The Mazda infrared or blackout flash lamps, made by Westinghouse and General Electric, are the 5-R and 22-R. The 22-R has a guide factor of 90 for 1/50 second; the 5-R has a factor of 55 for the same speed. And these guide numbers—when using standard infrared film with standard reflectors—may be applied to the table on page 1795 to determine exposure.

The slower shutter speed is preferable because smaller stops may consequently be used which, due to the peculiar drawbacks of infrared focusing, is a distinct advantage. As Philip Sperry of Wabash puts it: "Speed is unimportant in blackout flash because you're not shooting action; besides, at 1/200 you do not get the benefit of the full infrared output, so necessary in this work."

FOCUSING

Focusing for infrared offers a problem. When you have racked the lens forward to the point where the subject looks sharp, your camera is presumably focused sharply. However, what your eyes see as sharp is definitely unsharp in the "eyes" of the infrared light by which you are working. For your infrared image is focused sharply *not at the plane where your eyes see the image as sharp, but just in front of it.* This means you must deliberately rack the lens forward the intervening distance without being able to observe the result visually.

Sounds complicated and hit-or-miss? Not at all. As a matter of fact, if you are using the characteristically short focus miniature camera lenses and medium stops, you don't have to worry about compensation at all because you get depth of field to spare as it is. Generally speaking, correction varies with different lenses, focal lengths, lamp distances, etc.—about ¼ to 3 per cent of the focal length of the lens used. If stopped down to f/8 or less, anastigmatic lenses on hand cameras are usually satisfactory, according to Dr. Walter Clark, authority on infrared, who adds that "in actual practice,

most anastigmats working at f/4.5 and of focal length of 7 inches or less give fairly good definition at full aperture." (See *Infrared Photography* article by Dr. Clark.) Westinghouse reports that experiments indicate racking the lens forward 1/8 inch beyond the point correct visually is about right for a 4 x 5 or 3¼ x 4¼ Speed Graphic with normal lens. Wabash declares their experience shows that, using a 6-inch Tessar, near focusing of 1 millimeter (about 1/25 inch) was required for working distances of 8 to 15 feet. Some of the miniature cameras, where correction is least critical, have a special infrared marking, and Eastman's Ektar f/4.7 lens of 5-inch focal length incorporates infrared correction.

But how are you going to focus in the dark, most people want to know? Mabel Scacheri got an answer for that one from some press photographers who told her they pre-focus the camera at 10 feet and when things go dark they can tell by spoken words or a stumble when the subject is about 10 feet away and then "let 'em have it." That sounds like as good a method as any, but circumstances will bring individual solutions in many instances. The use of the Aero film and small stops at medium distances will minimize errors. In any event, since technical perfection cannot and is not expected in blackout flash work, slightly soft results will be acceptable in the finished photograph.

PRECAUTIONS

In seeking a formula for the infrared dye coating the bulb makers wanted two things: the greatest possible infrared output in combination with the least visibility. Despite their efforts, some visible light does escape in a dim purplish red glow, but this is not considered serious enough to do any harm. In fact, the amount of visible light that escapes from the bulb is so little that it is impossible to read it on a meter. Since the main objective is to avoid visibility of the flash by enemy airplanes during a blackout, it is sufficiently reassuring to know that experiments by U. S. Army engineers show the visible "black" flash extends for only 50 feet and then may be seen only if one looks directly at the flash from that distance.

Since infrared rays are heat rays, subjection to undue heat will tend to fog the film. Therefore, several precautions are necessary when handling this film. Cut-sheet film holders should be of the type which has the five little knobs on the grip edge of the slide; those with the three knobs are unsatisfac-



Special blackout make-up eliminates the chalkiness common to most infrared portraits. The skin and lips are tinted various shades of brown. DATA: 1/50 second, f/11, 1 Superflash Blackout bulb at 6 feet
Photo, Jacob Deschin



The infrared invisible flash in the totally dark Radio City Music Hall has caught this audience as it watched the movie screen. All were completely unaware of the camera. DATA: 1/50 second, f/4.5, 1 Blackout Superflash at 15 feet
Photo, Dan Grossi

tory as the material has a tendency to transmit heat, causing possible fogging of the film. Furthermore, holders should not be carried against the body, the camera loaded with infrared should not be unduly exposed to the sun, extra care should be taken not to place the fingers on the material. All these are important; violation may fog the film.

Identification of flashed bulbs calls for another precaution. There being no visible change in appearance of the bulb after flashing, and the chances being that it will not be practical to throw the bulb away after use, it is suggested that used bulbs be marked with white chalk or scratched with a metal point immediately after use. The bulb jacket itself, however, provides a check in a corrugation in one part of the bulb due to the melting and swelling of the lacquer by the intense heat of the flash followed by cooling in hard ridges.

Of rather limited value, though worth mentioning in connection with a medium



Picture making in night clubs, court rooms, concerts, and lectures is now possible with infrared flash. DATA: 1/200 second, f/8, 1 Blackout Superflash at 8 feet
Photo, Ralph Forney

which is still largely experimental, is the use of a special "blackout make-up" to eliminate the characteristic infrared chalkiness in faces and substitute an effect closely resembling the results obtained with normal photography. The make-up consists of applying a dark brown tint to the face and eyebrow pencil of a still darker brown to the lips. For the ordinary blackout uses, this will not, of course, be practical, but there it is for what it's worth.

USES OF INFRARED FLASH

What's the use of infrared flash photography? First on the list is, of course, the reason for which the bulb was named: to make pictures during a blackout without visible light. In other words, it affords the means of making pictures where pictures cannot otherwise be made, in situations, for example, where white flash is definite'y out of the question. This use has an interest almost wholly for the press photographer and the cameramen of the Army and Navy.

The photographic activities of World War II will bring out many new uses for film and among them may be infrared flash for night reconnaissance purposes.

The basic set-up obtains also in peacetime situations, such as documentary, surgical, and other fields of scientific research where the infrared make revelations not otherwise possible, photography of theater audiences whose reactions can thus be recorded without stopping the show or disturbing the audience, in work by the FBI in tracking down law breakers. When and if the film makers produce an infrared emulsion corrected at least approximately for panchromatism, Hollywood is prepared to welcome it with open arms, for that will mean that stills can be made during actual filmings. Picture making in night clubs, court rooms, at concerts, public lectures offer other possibilities as the infrared flash produces practically no noticeable light and may be used without disturbing people or making them unduly aware of the camera.

It should, above all, be borne in mind that everything we now know about infrared flash is subject to change. It is a field wide open to experiment and pioneering, and is becoming increasingly more important.

INSECT PHOTOGRAPHY

George Elwood Jenks
Photographer of Scientific Series,
Movie in Candid Snapshots

Specialists in the field of photography always have interesting stories to tell—and this one is about the technic and professional possibilities of insect photography. A photographer whose fascinating action pictures of the insect underworld have appeared in many magazines tells how to "shoot" the interiors of cocoons, egg-sac, and other hidden phases of insect life. There is also advice on how to assemble the essential photo equipment economically, and how to raise and keep the insects under observation.

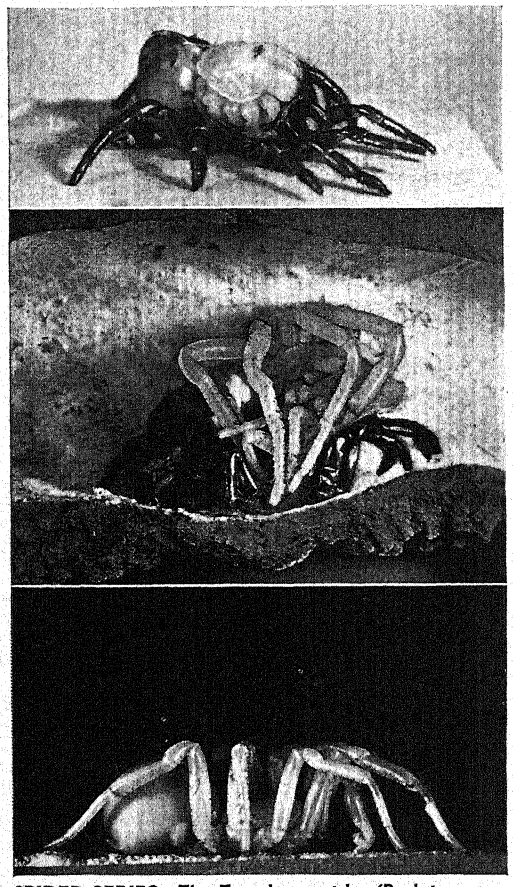
All illustrations by George Elwood Jenks.
See Also Ecological Small Living Animal Photography

THIS IS AN AGE of competition and specialization, where aimless dabbling never gets anybody anywhere. And this is particularly true in photography, whether you take it up professionally or simply for the joy of doing something that you *like* to do—and doing it well. Personally, I would rather get a series of "candid" snapshots of a warty toad laying its eggs in a wayside ditch than a hundred perfect photographs of beautifully mounted specimens in a museum or a taxidermist's shop.

Some workers use dead or anaesthetized insects, posed in a skillful simulation of life. Others mount them first. Still others prefer to work out-of-doors, getting the big thrill out of sneaking up on their quarry and shooting while it is momentarily at rest. But I want more than that—probably because of my years of training in the silent movies where I learned to tell my stories in action scenes rather than in words. Anyway, I prefer to keep at one particular species until I get a complete story in pictures, covering its entire life. The picturing of the life of any insect is fascinating to me—but the delving into the secret chambers and hidden chapters of their lives is almost an obsession. It seems that such mysteries become doubly alluring *because* they are hidden—as within a cocoon or an egg-sac.

For instance—a Black Widow spider lays her eggs, incloses them, and *hides* them within a tight bag of paper-like silk. That is the last we see of the pearly eggs. Weeks later, a tiny hole appears in the sac, and hundreds of almost-microscopic spiderlings

come popping out like bullets from a miniature machine gun. Occasionally, instead of baby spiders, the egg-sac "hatches out" a flock of peppy little parasitic flies. All this is very interesting, *but what happened* in the secret chamber of that egg-sac?



SPIDER SERIES. The Trapdoor spider (Bothriocyrtum californicum) in an early stage of its molt *(top)*. The spider's skin is so tough that it will not stretch. So, when it outgrows its "clothes," it must throw them away. The new skin is provided by secretion from surface glands. The male Trapdoor spider in the final struggle of its maturing molt *(center)*. And *(below)* the spider after a few hours, beginning to revive but still in the process of acquiring the new outer layer

Or we see a fat maggot stop eating a half-devoured trapdoor spider and proceed to spin a marvelous two-story cocoon. Months later, a circular lid is cut from within the cocoon and out crawls a beautiful, blue-black wasp. All this is plain to be seen, but *what happened inside* to change a skinful of liquified spider meat into a delicate, highly-organized, winged wasp?

And so it started. I simply *had* to explore such hidden territories and photograph all the mysterious things that happened there. But how? There would be many different stages through which a fat larva would have to pass in order to become an adult wasp. And I wanted photographs of each and every step so that I could build up the life-history series into an unbroken "continuity" of action "scenes"—just as a moving picture is constructed.

So I must catch the developing insect just as it was passing through each successive stage. The usual way, of course, would be to collect and cut open many different cocoons, trusting to luck to find specimens that happened to be going through the desired stages. But that would be expecting almost too much from Lady Luck—even when working with some common species where it would be easy to find and examine a great many specimens. But I was specializing on a wasp which was very rare—so rare that I might easily have to dig up a thousand trapdoor spider nests in order to find 25 or 30 cocoons of the rare wasps that preyed upon them. That alone, would mean months of work and, at best, the odds would be overwhelmingly against my finding specimens just passing through each of the many required stages. So that method did not seem to be very promising.

AN INSECT OBSERVATION WINDOW

Obviously, the ideal method would be one in which a single insect could go on living its natural life under conditions that would enable me to keep it under constant observation and to photograph it as often as desired. If such a cocoon were opened and left open, the transforming insect would probably dry up and die. And then I remembered an article I had read in a scientific journal telling of an experiment in which surgeons had placed an "observation window" in the side of a living cow. By means of this glass window, they hoped to study the digestive processes, and learn more about how the cow transformed grass into milk. It was claimed that Bossie was quite comfortable and chewed her cud as contentedly as when she stood beneath a shady oak in her home pasture.

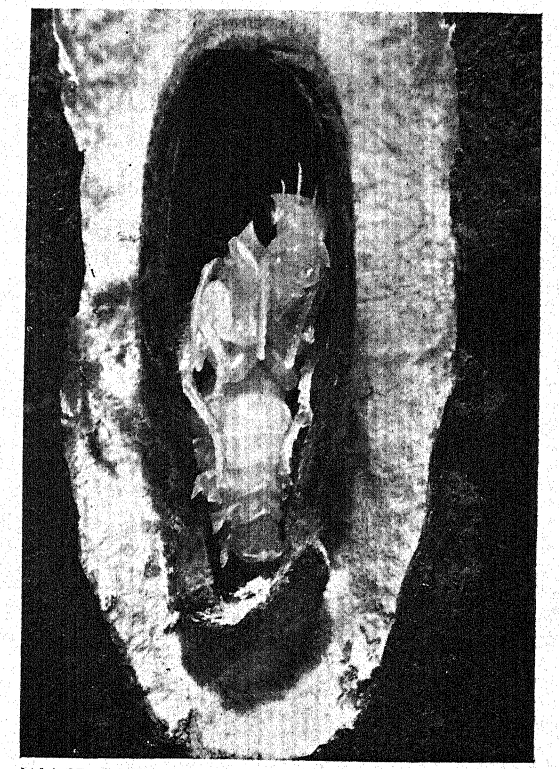


WASP AND SPIDER SERIES. The "Psammy" wasp (Pedinaspis planatus) lifting the lid *(left)* and entering the nest of a California Trapdoor spider. To get this shot, two cages were combined to make it wider from front to rear, so that there was room for the "planting" of a trapdoor nest in the dirt. The spider *(center)* was paralyzed by the wasp. The wasp laid her egg on the spider's abdomen and here the half-grown wasp is feasting on the huge store of fresh meat provided by its mother. This shot was made by grinding away about one-third of the spider's tube so that it would fit against the front glass. The mature larva of the wasp *(right)* is starting to spin her cocoon after the partly-devoured spider had been removed. The mouth of the larva has become an efficient spinneret, spinning treads rivalling those produced by spiders

An observation window was just what I needed. And it was much easier to put one in the side of a stiff, inanimate cocoon, than in the side of a living cow. It was only necessary to cut an opening in the side of a cocoon, fit the cut edges snugly against the glass, and hold it there. It would not do to *glue* the edges to the glass, for the glass must be removable so that it might be cleaned and the specimen arranged as required. And so, with this idea as a starter, plus a lot of experimenting in lighting, exposure, handling of specimens, etc., I worked out these simple, inexpensive photographing cages—my way of putting observation windows in the secret places of Nature.

As shown in the illustrations, a photographing cage is simply a cut-out board or several layers of stiff cardboard sandwiched between two panes of glass. The size of the cage opening and its depth (thickness between the glass walls) depends upon the size of the insect to be observed and photographed.

A cage of the proper depth having been prepared, a shallow section is cut out of the egg-sac with a fine pair of curved manicure scissors. Then the eggs are carefully removed and the main part of the sac is fastened to the rear glass with a tiny drop of glue. Next, the cut edges of the sac are carefully trimmed until it fits snugly against the front glass when the cage is closed. Now the cage can be set upright in its slotted base and



WASP AND SPIDER SERIES. The developing pupa of the "Psammy" wasp in the trapdoor spider nest. In this case the cocoon, as well as the spider's tube, was fitted closely up against the front glass

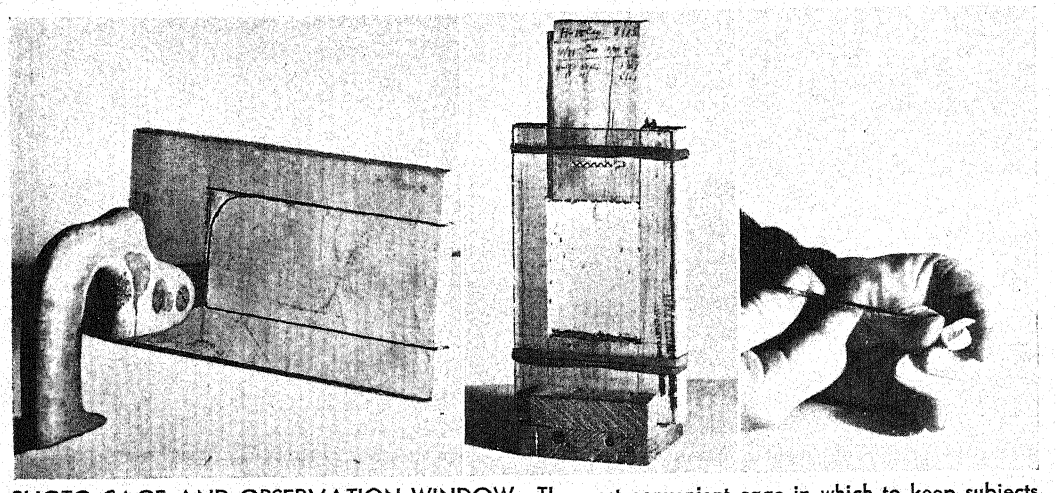


PHOTO CAGE AND OBSERVATION WINDOW. The most convenient cage in which to keep subjects may be made out of a piece of pine board. A center section is cut out *(left)* and the slide is then made to fit snugly with cardboard. The cage is completed *(center)* with a glass front and back held in place by bands. The size and width of the cage will depend, of course, on the type of insect used. The egg-sac or other material for observation may then be prepared *(right)*. A shallow lid is cut in the sac and the eggs are carefully removed

held firmly in place with wooden wedges. A cocoon is handled in exactly the same way. Even a large nest, like the "tube" of the trap-door spider, can be fitted into a larger cage, as shown.

EQUIPMENT

Now that we are ready to shoot, what kind of a hunting outfit will we need? That depends somewhat upon the condition of the pocketbook, of course. An expensive outfit is *not* necessary.

Bench. Lumber, glass, and an old inner tube furnished the makings for the photographing cages and for the camera bench—about eight feet long and built like a rough carpenter's bench, as shown in the illustration.

This bench must be well stiffened with "X" braces, to prevent all vibration. Both the top and edge of the board or plank used for the camera runway should be true and straight. A guide block should be clamped to the camera track and, when the desired focus is obtained, the camera clamped tightly to the bench. The photographing cages are set on a "model stand" which is adjusted, or built up with blocks, to line up the subject with the lens.

Camera. Now for my "oversize" candid camera. The "foundation" is an old 8 x 10 view camera with a 28-inch bellows ex-

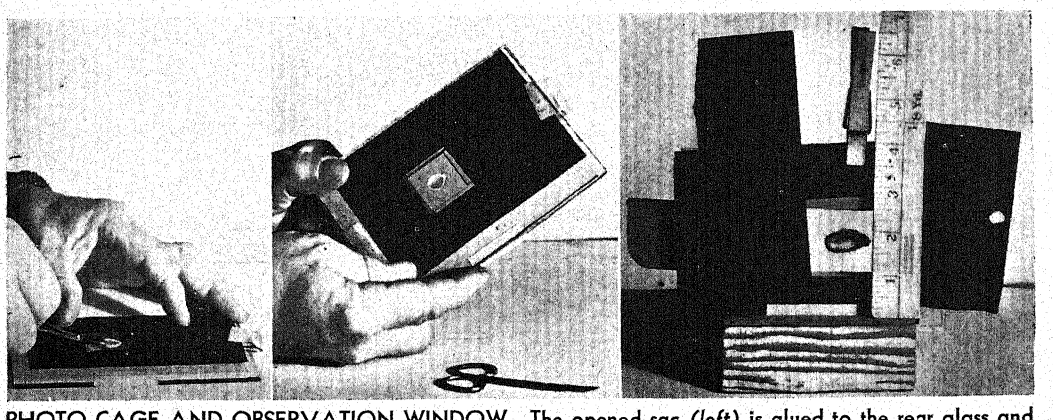
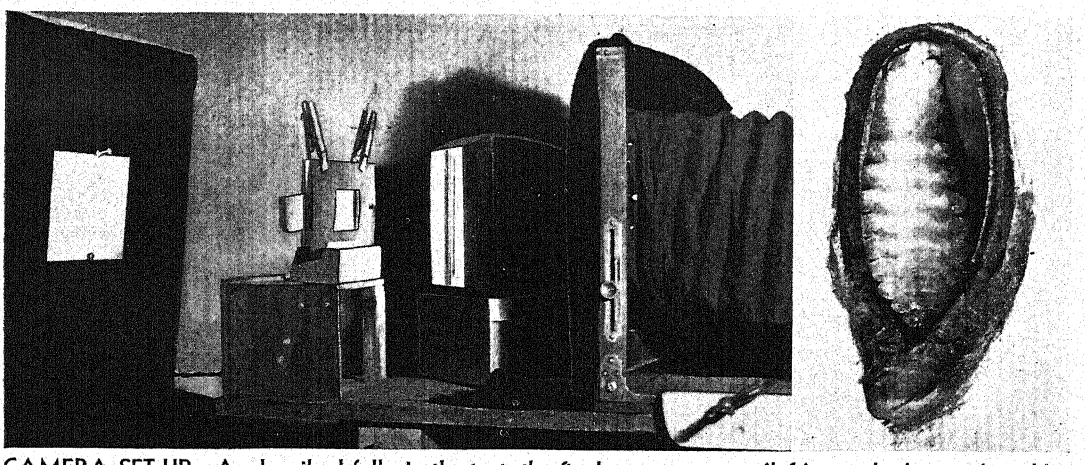


PHOTO CAGE AND OBSERVATION WINDOW. The opened sac *(left)* is glued to the rear glass and the edges are carefully trimmed until it fits snugly against the front glass *(center)*. Then the eggs are replaced. The finished observation window *(right)* may be photographed with a ruler, to show exact magnification

tension. I made a lens board to hold the small 6½-inch lens which I stole from my cheap Kodak. This outfit gives me a four-times magnification on the negative when the bellows is fully extended, and the negative can be enlarged as desired in my amateur enlarger.

The usual way is to shoot human beings with a tiny candid camera. But I have a huge candid camera, 28 x 8 x 10 inches, for shooting tiny insects! And I do not want to make 8 x 10 negatives. For small insects, 5 x 7 is plenty large enough—and for certain technical and economical reasons, half that size is even better for many subjects. So I must have reducers and I made them out of old 8 x 10 film holders that came with the camera. I made the "slides" to hold my 5 x 7 and 3½ x 5 films by glueing strips of hard, tough cardboard into the two slides of 8 x 10 film holders.



CAMERA SET-UP. As described fully in the text, the final camera set-up *(left)* may look something like this. And magnified cut-out images of the living specimens are then possible. At *right* is the developing "Psammy" wasp larva

REDUCING REFLECTIONS

Why do I not use a 5 x 7 bellows for the 5 x 7 film? For the very good reason that the use of the 8 x 10 bellows helps quite substantially to reduce fogging in this type of photography. If you doubt it, try it out for yourself. Just set up your camera, cage, and turn on your lights. Now remove your groundglass and cover your head with the focusing cloth as you look through your camera. You can probably see every fold of your bellows? The inside of the bellows is visible to your eyes because it is dimly lighted by extraneous rays of light passing through your lens and hitting the inside of the bellows—regardless of the fact that the bellows material is supposed to be non-reflecting. Obviously, every ray of light that reflects from the bellows to your eyes would also hit a negative and fog the brilliance of the negative just that much. And just as obviously, if you "set back" the inner walls of your bellows 1½ inches or more, all around, *fewer* of the wandering light rays will hit the walls outside of your picture lines and be reflected on your negative as fog.

The glass cages, too, can be mischief makers. The glass, especially with a black background, makes a too-perfect mirror for reflecting light-colored walls and objects above and back of the camera, and the front of the camera itself. Dark walls and ceilings are ideal for this work, but if they are not obtainable, black curtains can be hung to cover the light, dangerous areas. No light object or wall should be allowed to reflect itself from the cage into the lens. The front of the cage, except for the actual opening, should be covered with black mat paper, and the front of the camera draped with black cloth, and no bright brass or nickel left exposed—or you are likely to be disappointed to find baffling light areas on your prints.

All this may seem fussy and even unnecessary, but every one of these little pre-

cautions will help to reduce fog to a negligible minimum and to give you clean-cut, brilliant negatives.

LIGHTING ARRANGEMENT

Now for the lighting. Of course, this is quite a problem, particularly when photographing dead-black subjects like a Black Widow spider. The greater the magnification, the longer the exposure must be. When a short focus lens is stopped down to a small aperture and you are using a 28-inch bellows extension, you are doing what is practically pin-hole photography. But we must often use small apertures for large insects in order to get both the nearer and farther legs in sharp focus. And, as it gives a deeper field of sharp focus, I usually work at 2X to 4X and depend upon the enlarger for raising the insect to the right size for a 5 x 7 print.

All of this, in addition to the fact that we must have short exposures in shooting action, means that intense lighting must be used. For this I use cross lighting with photoflood lamps. I usually set these lights up within six inches of the cages—and that means they will throw a lot of heat. So it is important to set them well back while focusing and composing your picture, and place them up close only while making the exposure. Many insects are easily killed by too much heat and if you "cook" your "goose" it won't be able to "lay another golden egg."

No set rules can be given for exposure. It varies too widely with the color and magnification of the insect, as well as the intensity of your lighting. I have used the old "trial and error" method until I have a rough exposure table in my head. You will have to work out your own according to the outfit you use.

For shooting active insects, flashbulbs are necessary. My camera shutter and the flash are not synchronized—which is just as well, for I find that I often need the full flash for adequate illumination. But, even so, it is much safer to wait until the insect slows down—and then shoot. Remember, if the little bug is walking briskly in the cage when you are shooting at 4X, its image is walking across the negative at just *four times* that speed. So try to catch it when it pauses. A helpful trick when working with too-active insects in cold weather is to keep the room cold enough to chill some of the ambition out of them and then shoot them before they can get limbered up.

And right here is a good place to warn you that, in this work, you cannot always expect perfect photographic quality in lighting, composition, etc., any more than a newspaper photographer on a riot assignment can expect to compete with a studio worker who has all the time in the world to consider his artistic qualities. In this work it is real life

(*Continued on page following insert*)



COMPOSITION ANALYSIS for . . . LEDERLE LABORATORY

In the very citadel of modern science, a figure almost as mysterious to the layman of today as was the medieval alchemist of the past, sits at work in a research laboratory. The arresting photographic character of this picture is due chiefly to the austere dark and light arrangement. The figure helmeted and robed in black is scarcely visible in the surrounding black. The exposed portion of the face, the bare hands with their precisely converging needles are in stark contrast.

Here is pictured a human being as a refined instrument, using other refined instruments of glass and metals to probe into the reactions of biological chemistry to promote health. Symmetrical ranks of testing equipment flank the worker at either side, preserving the fine bodily equilibrium so necessary to anyone using fine muscles in delicate control. These repetitious forms also give framing and concentration to the center action.

It is tantalizing not to be able to see some form or texture in the material which the scientist is stirring. However this keeps up the mystery. The foreshortened glass disc with the two micro plates are strategically placed to culminate the directions of fingers and needles. The two test tubes and bunson burner complete the balance. Throughout the picture the live play of light through the crystal glancing and reflecting over the polished surfaces is important.

So well has Dmitri Kessel succeeded in expressing the seriousness of the work and the worker's absorption, that one feels like holding one's breath so as not to jiggle a cell.

Barbara Morgan



LEDERLE LABORATORY

DMITRI KESSEL

DATA: 1/50 second, f/22, 3 flashbulbs



WATERFALL

J. MOSKOVITA

Wild movements in the water and a forceful sky pattern give plenty of action to this water scene. The triangle of black rock at the left is important to the picture, too, as it is the solid mass over which the potent action takes place



VEILED

ERIK NITSCHE

Clever use of translucent material has made this something new and interesting in nude photography. And careful lighting and exposure have brought out the right amount of detail both in the figure and the material



STILL-LIFE COMPOSITION — KONRAD CRAMER

This bowl arrangement is simple in the extreme—a well planned photograph by the author of the article on *Composition.* Notice how texture is important to the picture, as well as the simple circle and the opposing grain lines of the boards

(*Continued from page preceding insert*)

action that we want—caught at just the instant when it is most dramatic and significant.

LIVING ROOM LABORATORY

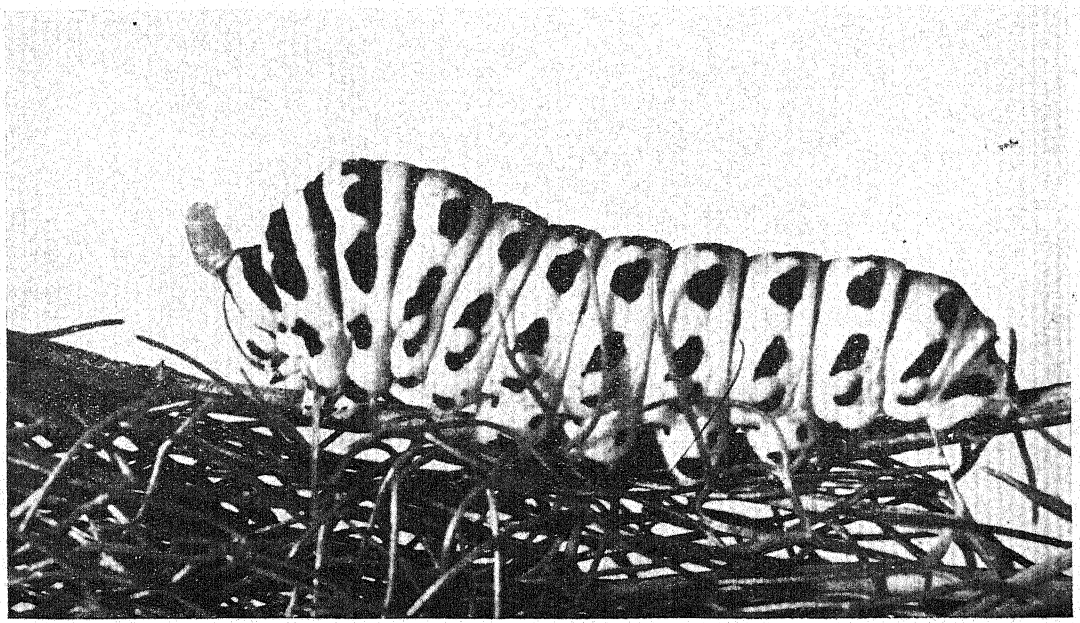
Now for the insects. More or less laboratory rearing will be necessary because you must not only have them where you can study their habits, but where you can watch them constantly for the important changes you want to photograph. And the rearing and propagating laboratory equipment need be no more expensive than that which I have described for the photographic angles of the work. Mine occupies one corner of the living room. Its "cabinets" are mostly cupboards, made of apple-boxes sawed in half. On these narrow shelves, I set my "breeding jars"—empty pint and half-pint salad dressing jars, with holes punched in the covers for ventilation.

It is a very good idea to have several "specials" to work on. Then you can turn from one to the other and keep busy while waiting for growth and developments. In this work you must be like a maternity doctor—always on call. Otherwise you will be sure to miss some important stage—a moment in the development of a pupa, or an emerging adult. Here the homemade laboratory in the living room has one great advantage over the finest "downtown" laboratory where you might be working on an eight-hour shift. Bugs have no respect for union hours, but in your home, it is possible to keep an eye on them night and day. Many a time when I have been expecting an addition to my insect family or an important development of some kind, I have set my alarm clock, slept in one-hour shifts, and so caught them in the act, thereby capturing rare and valuable scenes.

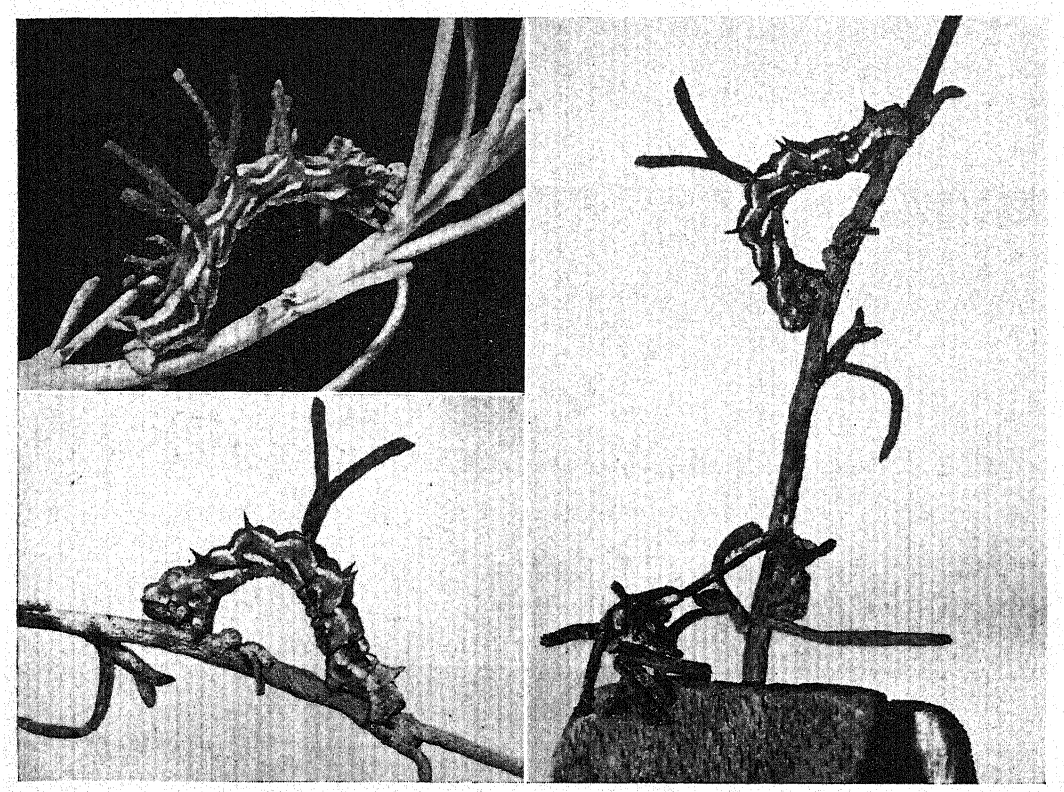
So the laboratory rearing of your "specials" is very important. It would require another article to cover all the important details but I will give a few helpful hints here.

Spiders and carnivorous insects should be fed with insects similar to those they prey upon in nature, but many of them relish bits of ground beefsteak. On the other hand, you will be surprised to learn how many adult insects are strict vegetarians. Bees, wasps, and many other insects will thrive on synthetic "nectar"—honey diluted with water about 1 to 10 and served in a *small* pellet of absorbent cotton.

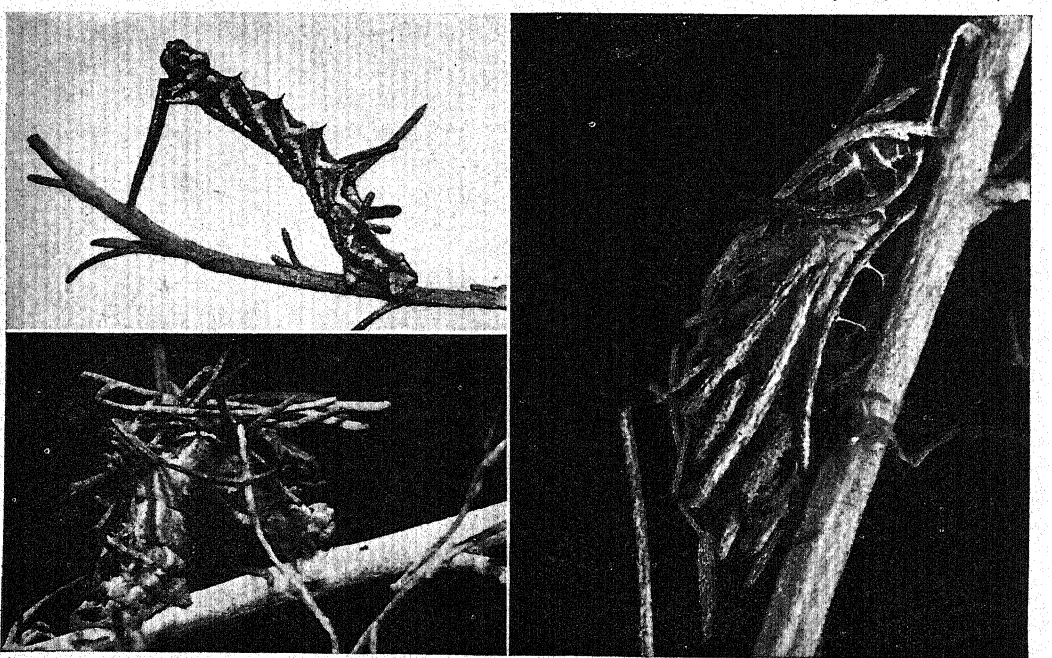
Don't be stingy about your stock of specimens. Accidents happen and various developments fail to materialize. If your last



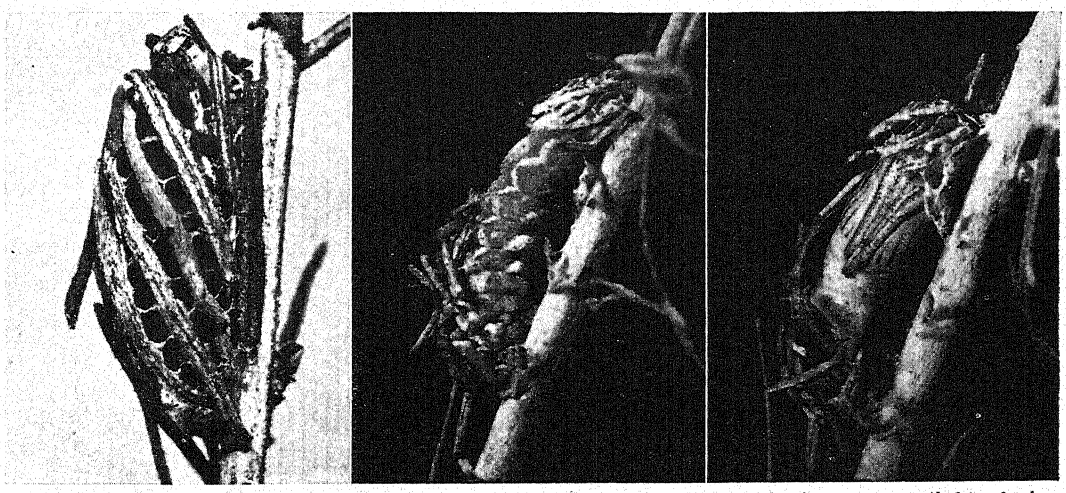
SWALLOWTAIL BUTTERFLY CATERPILLAR. Caught when its defensive scent bag was fully blown out. This illustrates the advantage of a narrow cage, where the subject cannot move out of focus



SAGEBRUSH CINDERELLA SERIES. This rare little "looper" caterpillar, of the Nemoria californica moth, makes its own ragged clothing out of leaves of the California sagebrush *(top left)*. The half-inch caterpillar soon outgrows her skin (right) and has to molt. She then puts more leaves onto her spine *(bottom left)*



SAGEBRUSH CINDERELLA SERIES. The sagebrush also serves the caterpillar with food *(top left)*. And this existence continues until a metamorphosis begins *(bottom left)* and a cocoon is made *(right)*. This precise basketwork cocoon she weaves around herself with caterpillar "silk"

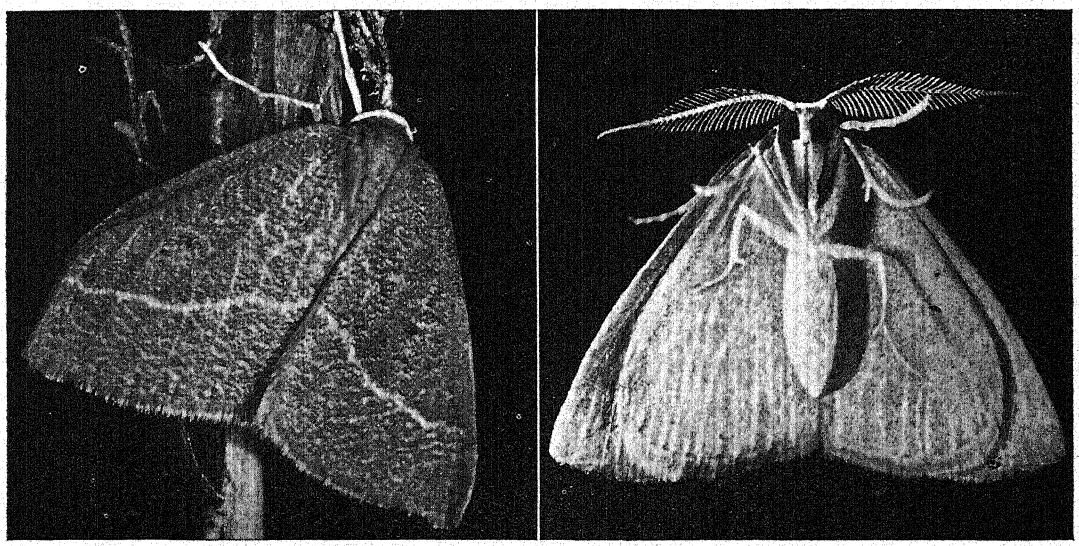


SAGEBRUSH CINDERELLA SERIES. The caterpillar now has a close-fitting basket cocoon *(left)* which is removed to reveal *(center)* the caterpillar, which has become shorter and thicker. The skin of the caterpillar then splits to reveal *(right)* the pupal case

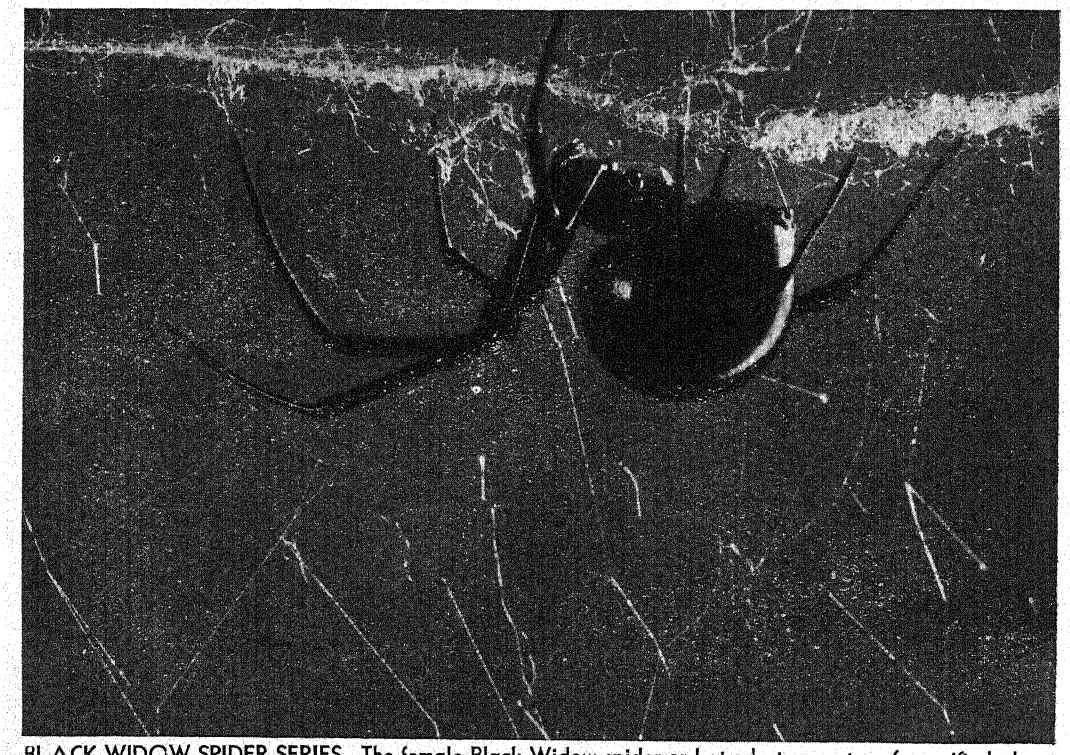
specimen of any species dies before you get your required scenes, a whole year may pass before you can get other specimens at that particular stage.

You can economize on cages by keeping most of your "specials" in breeding jars, and then transferring them to photographing cages as they seem to be approaching the desired development. And, since this work must be done scientifically to be valuable, paste a sticker on every jar and cage and keep a date record of every important change or development. Every negative, also, should be numbered, and a careful record kept of the date, magnification, and important points. All of these things are important in the eyes of scientists—and *necessary* if you are lucky enough to find a new species and want it identified and recorded by a scientist. You may *think* you can remember all these details, but if the years pass and the negative numbers run into the thousands, you *won't.*

Another helpful hint about feeding your insects, where you have to remove the cover. In trying to escape, nearly all insects crawl



SAGEBRUSH CINDERELLA SERIES. A beautiful pale green winged moth eventually emerges from the pupal case *(left)*. At *right* is the male Nemoria californica moth

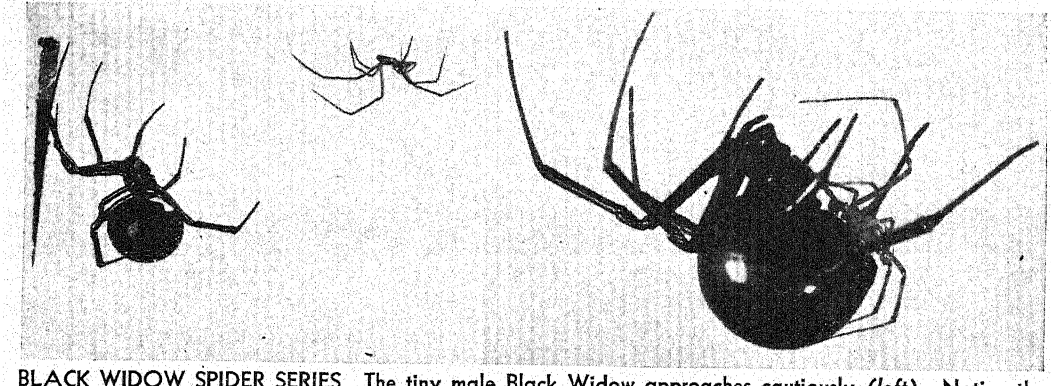


BLACK WIDOW SPIDER SERIES. The female Black Widow spider or Latrodectus mactans (magnified about 3 times), shown making her patternless web of strong silk threads. This photograph and others in the series were made in a cage as shown on page 2110

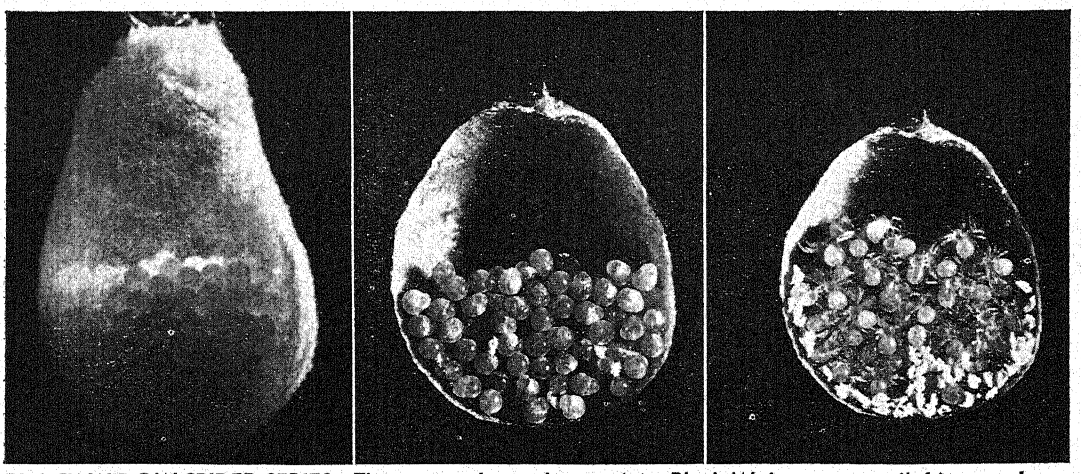
or fly *up*. So, in capturing or recapturing one of them, let him have his own way about it and save trouble. Don't try to force him down into the jar. Just invert the jar, clap it down over him, and he will do the rest. Remember, too, that spiders can often go a long time without food but they must have water. Water should be served in pellets of absorbent cotton, just as the honey-and-water is given to wasps and flies. But you will soon learn all these tricks and many others with experience in conducting an insect zoo.

STALKING THE INSECTS

But, of course, we must "catch our fish before we fry them." For wasps and flies I use a butterfly net. My own hunting



BLACK WIDOW SPIDER SERIES. The tiny male Black Widow approaches cautiously *(left)*. Notice the distinguishing red (white in the photograph) hourglass design on the abdomen of the female. And at *right* is the strange synthetic mating act of spiders. There is no actual contact of the sex organs, the fertilizing fluid being carried to the female in the male's palpi or feelers at his head



BLACK WIDOW SPIDER SERIES. The eggs and inner lining of the Black Widow egg-sac *(left)* were photographed with lights placed back of the cage. The sac is finished by the spider by applying liquid silk "plaster." The interior of the egg-sac *(center)* shows the eggs about to hatch. After hatching *(right)* the spiderlings are transparent and they will remain in the sac for 3 or 4 weeks, molting at least once

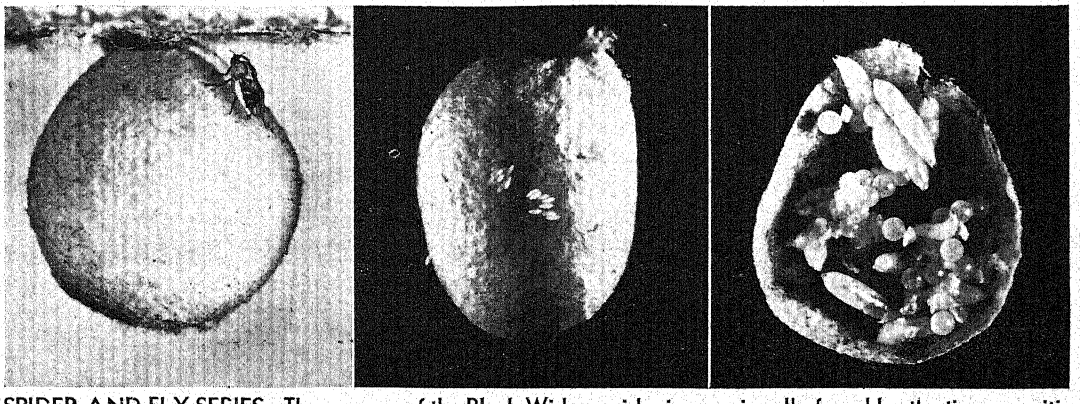
ground is a large patch of wild anise where, during the flowering season, thousands of bees, wasps, and flies gather from miles around during the two months when the anise is in bloom. But any large patch of nectar-bearing blooms will be found to be a good hunting ground.

For catching other insects which inhabit the leaves and branches of trees and shrubs, I have found the old, old method of "beating the bushes" most effective. To do this, an old umbrella is inverted and held under the bush while it is bent over and beaten sharply with a stick. This causes a shower of miscellaneous insects and rubbish to fall into the umbrella. Now we must work fast, for many of them begin to hop or fly away. The great majority will be of common and valueless species, but every once in a while we will draw a prize, a rare or interesting species, and work it safely into a glass vial.

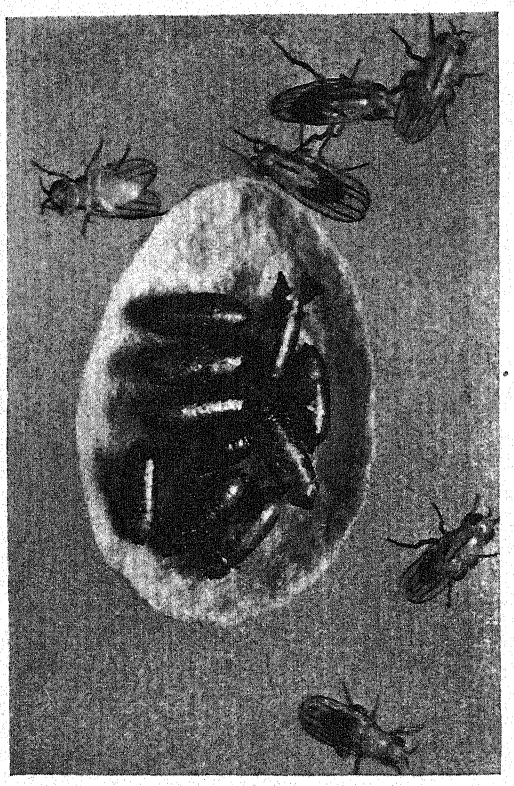
Two years ago as I pawed over a catch, mostly leaves and twigs, my seven-year-old son pointed excitedly to something. I looked, and decided it was only a bit of a stick.

"But, Daddy, it's moving!" he insisted.

Sure enough! It was a tiny beetle which proved to be so fascinating that I made a "special" of it. We found many other specimens but it was two years before the photographic life history was completed. It sold promptly and, on top of that, scientists



SPIDER AND FLY SERIES. The egg-sac of the Black Widow spider is occasionally found by the tiny parasitic fly, Gaurax araneae, Coquillett. The fly *(left)* lays eggs on the sac and these hatch *(center)* to form almost microscopic larvae which worm their way into the sac. Once inside, the parasitic larvae of the fly devour the Black Widow eggs *(right)*



SPIDER AND FLY SERIES. The new parasitic flies emerge from the egg-sac, leaving their own empty pupa cases in the sac

found that it was a new and unknown species—and named it after me—although my boy really deserved the credit.* And the little "Cinderella" caterpillar whose life story is shown with this article was found under very similar circumstances.

THE AMATEUR SCIENTIST

You never need hesitate to take up this work because you are not a trained, general entomologist. Neither was I when I took up this work—nor do I ever expect to be. As free lance amateurs we have one great advantage. The professional general entomologist must study, and be more or less familiar with, a thousand "bugs"—and so is sadly limited in the time he can devote to any *one* species. But *we* can *specialize* without limit. We can select one, two, or more species, and study and photograph them for years, if we wish. Which means that *we* can put in, on any one insect, more actual time than any general entomologist.

*See *Nature Magazine*, June-July, 1940.

And so—if we possess even average intelligence to start with—we *ought* to learn something about that insect's life history which will be new to science. And that will mean that you have graduated from the great common class of pop-gun snapshotters and have entered the class of real scientific workers. And you will find that there are many scientists, thoroughly trained in the complexities of insect classification, who will be glad to help you with identifications.

Even as a part-time hobby, this method of working will open up the way into the fascinating world of Nature's secret places. And if you take it up seriously and persistently, as I have done, here is a comforting thought—you will have very little competition. However, don't count on making much money out of it during the first or second years. I spent nearly three years securing and perfecting my "Black Widow and Parasite" material before I sent out my first life history "Movie in Candid Snapshots." So, obviously, this particular field is not a promising one for dabblers.

Patience and stick-to-itiveness are the most important items of all the equipment. You will often have to stand for an hour or more with your hand on the flash switch, waiting for your tiny temperamental actors to do the scene just as you want them to do it. Sometimes you will have to wait for weeks and months for just the right season for getting a few development scenes to complete a life history.

INSTITUTIONAL AND INDUSTRIAL FILMS

O. H. Coelln

Editor and Publisher, Business Screen, *Chicago*

The field of institutional motion pictures includes industrial and commercial films, public relations, selling, and training films, and the newer type of motion picture promoted by the government. The output of non-entertainment productions is truly vast, though overshadowed by the spectacles from Hollywood. Films are used by such varied institutions as: The United States Government and armed forces, Curtiss-Wright, Hiram Walker, Sigma Chi Fraternity, Lutheran Church, General Motors, and the Community Chest.

See Also Documentary Photography, Filmstrips, Production Photography, Visual Education

THERE IS A WORLD of film-making outside the familiar boundaries of Hollywood that may yet outrank that fabulous capital in

actual volume of production and in public interest. What may seem like bold prophecy is today being slowly but inevitably justified by the increasing scope of activity being carried on in the production of pictures for war production plant training, for vocational schools throughout the nation, for the Army, Navy, Marine, and Air Corps, for government information services, in the field of medicine, and throughout the field of merchandising and distribution.

There are 15,000-odd entertainment motion picture theaters in the United States but there are more than twice that number of non-theatrical 16mm sound motion picture projectors in almost daily operation in schools, industrial plants, churches, meeting halls, and other public gathering places. The Army and Navy have acquired thousands of additional 16mm sound equipment units for training purposes.

The popularity of the film as entertainment and the lengthy queues which pay box office homage to its legendary stars make it easy to forget that the motion picture also possesses unique powers to impart a high measure of understanding to the average human in a very short space of time. Converting that power of idea communication into the understanding of complicated mechanical and scientific processes, of modern selling psychology, problems in human relations, and explaining other complex elements in the social-economic order in which we live are the objectives of the institutional and industrial film.

FILMS SPEED LEARNING

While overshadowed by the public attention bestowed so lavishly on the entertainment film, the application of films to the task of explaining, teaching, and selling demonstrates great and latent power. We still depend on the printed word for advertising and instruction but words often fail us in this complicated world. They have varied meaning. Used in combination, words do not convey the same thoughts to each reader. In the process of reading, symbols are translated into mental images, colored by experience. The succession of images thus presented may not be correct or in the proper order. This conversion of symbol into mental image is eliminated by the motion picture, for the visual presentation on the screen is definite and precise. All observers see the same object at the same time.

To this fundamental theory of industrial film production must be added other values: concentration of attention (the darkened room, lighted screen, and elimination of outside distractions), speed of perception and learning, and the length of retention. All these contribute to the industrial film's power to train men and sell goods. Not only its dimensional realism but a combination of favorable psychological factors make this the medium one executive* termed "the greatest medium for putting ideas into men's heads that ever came into selling!"

NOT FOR ENTERTAINMENT

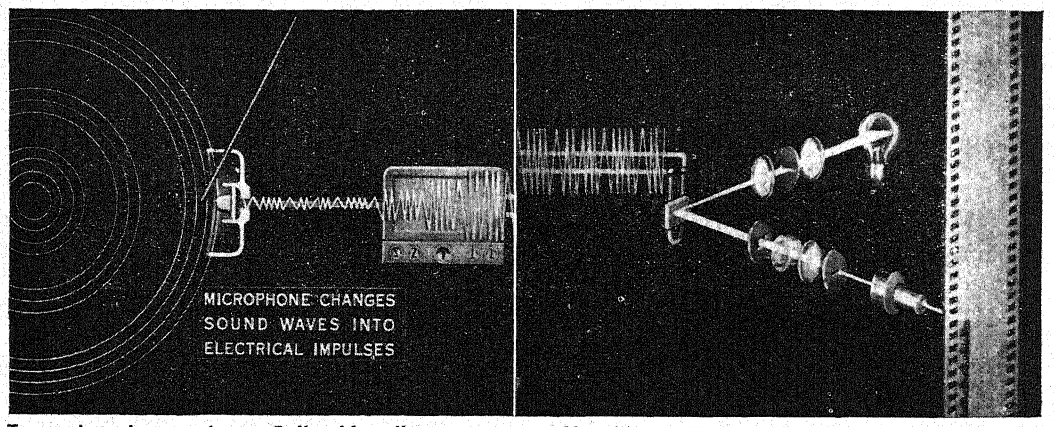
A lesson still to be learned by many sponsors and producers as well is that the institutional and industrial film is a medium in its own right. All who produce motion pictures are indebted to Hollywood for the development of sound and camera equipment, lighting technics, and color processes, etc., but those who also borrow the actors, settings, and familiar plot treatments may as well be trading the power of the medium for a mess of movie fan pottage.

The industrial film demands originality of treatment and every possible advantage in production excellence. It is not an experimental ground for the cinematographer such as the social-documentary. Its primary mission is to deliver the sponsor's message to the minds of a selected audience with the greatest possible effectiveness. Anything that delays that mission—lack of production quality, trick technics, overly attractive star personalities, poorly recorded sound, and other obvious shortcomings—serves to discredit this useful medium. Its great handicap is the willingness of the prospective producer to engage in a task beyond his ability.

FIELDS OF PRODUCTION

For the industrial film's problem is lack of definition and a badly needed code of limitation. Living in the shadow of the entertain-

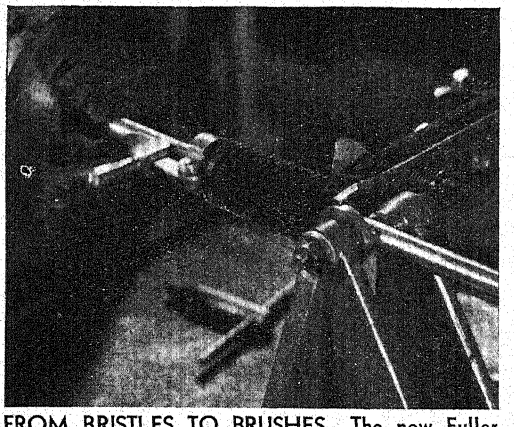
*Richard Grant, vice-president, General Motors Corp.



Two technical scenes from a Bell & Howell motion picture, *How Motion Pictures Move and Talk,* showing the use of industrial film animation. The electrical impulses which turn voice and music into sound on film are illustrated

ment art, entire fields of production have remained undeveloped. Not until the advent of sound motion pictures and the subsequent development of 16mm sound motion picture projection did the present widespread development of the industry emerge. Today it serves three principal fields of activity. These fields of purpose—the objectives of nearly all industrial film production—may be classified as follows:

Selling films to establish acceptance and make sales of products and services; *training films* to instruct in the operation of mechanical devices, selling technic, and other complex tasks; and finally, a broad class of *informational and institutional films*, indirectly selling, but primarily concerned with explanation of policies and problems in public and industrial relations, informing citizens and stockholders.



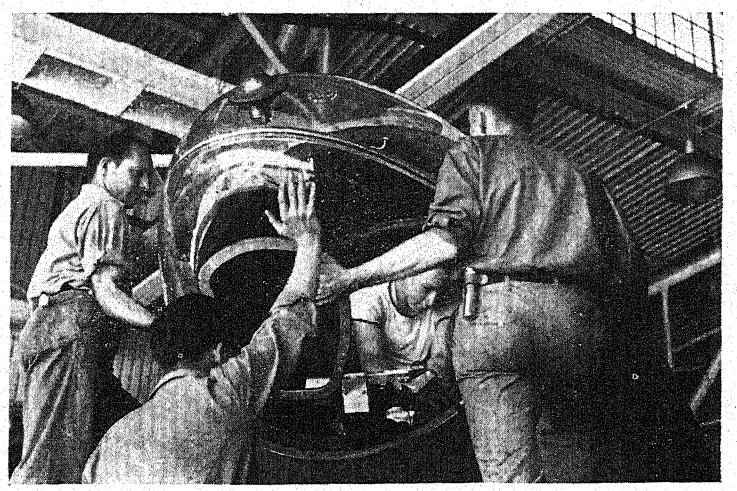
FROM BRISTLES TO BRUSHES. The new Fuller Brush picture was produced by Castle Films, Inc. and is another example of the industrial film's contribution to public understanding. The scene shows the making of small bore gun brushes

The range of sponsors may well begin with the United States Government which today uses films to inform citizens on the progress of the war effort, to train apprentices for war plants, to educate farmers for improved agricultural output, and for a hundred other related purposes. From that auspicious beginning, the field of sponsors broadens to include a majority of the largest industrial firms in the country, particularly those concerned with mass production, thousands of smaller concerns, associations, commercial interests, and public organizations. Funds are solicited for charitable organizations, cemetery lots sold, airplane piloting taught, hen-raising technic is described to farmers, and the use of the latest pharmaceutical discovery explained to the medical world.

The names of present-day sponsors of such production reads like a "Who's Who" of American commerce and industry: General Motors Corporation, American Telephone & Telegraph, Curtiss-Wright, National Broadcasting Company, International Harvester, Coca-Cola, General Electric, United States Steel, Aluminum Company of America, the National Association of Manufacturers, Swift and Company, and hundreds of others equally important.

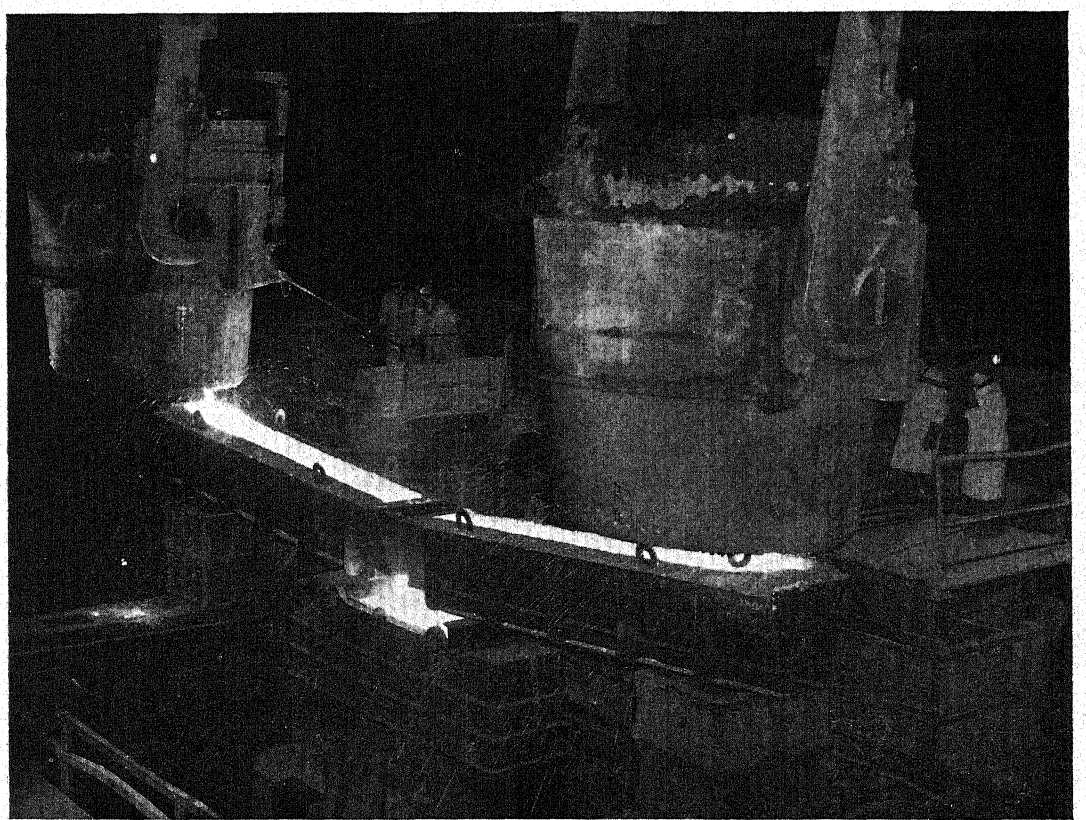
But the medium also serves a wide variety of other organizations, some widely dissimilar, such as: The Women's Christian Temperance Union, the Community Fund, Hiram Walker, Anheuser-Busch, the Better

Vision Institute, Sigma Chi Fraternity, Montgomery Ward, Sears Roebuck, the Lutheran Church (Missouri Synod), and the Servite Fathers, a Catholic order. Practically the entire field of automotive products, the oil and rubber industry, a large segment of the food and beverage industry, the heating and home appliance fields, and the insurance field are outstanding groups of businesses listed in the roster of recent production.



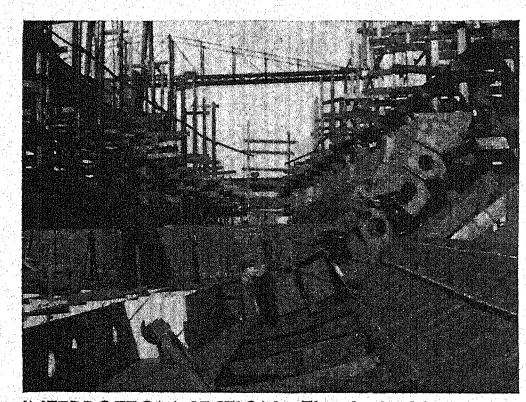
BOMBER. One of the scenes from the government's documentary film *Bomber*, made by the Office For Emergency Management Film Unit

Growing apace with these sponsors is an entirely different type, the industrial and personnel training departments of plants. Films sponsored by the United States Office of Education for machine tool and shipbuilding training have been used in this field but an increasing number of outstanding plants have complete visual programs. A notable example of this is the Thompson Products Company. In its new Euclid,



STEEL FOR VICTORY. This was produced by the Jam Handy Organization for the United States Steel Corporation. Steelmen are shown teeming half a million pounds of steel, the output of two open hearth furnaces

Ohio plant, the company integrates all new employees with the aid of motion picture subjects, and later trains intensively with the same medium. General Motors, Chrysler, General Electric, Bethlehem Steel, Carnegie-Illinois Steel, and Proctor & Gamble are other companies with extensive activities in this newly developing field.



INTERBOTTOM SECTION. The shipbuilding scene is from the United States Office of Education shipbuilding series, produced by Caravel Films, Inc.

And the final form of the film varies, too, all the way from a full-length feature to a "minute movie." In general, the technical make-up of the pictures in this field may be broken down into the following:

1. Feature length productions
   With plot and cast or a factual documentary with expository theme—covering a broad phase of the field
2. Short subjects (1 or 2 reels)
   Practically all pictures in this field are factual expositions
3. Advertising playlets
   These minute movies are 90 feet in length, on 35mm film.
   They use a short incident, news event, or animated cartoon to present the name of the service or product to an audience.

HISTORY OF INDUSTRIAL FILMS

How these sponsors of production utilize the institutional and industrial medium deserves serious study. Like Topsy, early commercial films were born and "jus' growed." They even preceded the present-day entertainment picture by a good many years. This historical era is more interesting than influential. For motion pictures were apparently destined as a public novelty and that distinction has been well preserved by respective generations in Hollywood.

Historically speaking, the first motion pictures viewed publicly date back to the closing years of the last century. In 1895, the flickering shadows projected on the painted wall of a Broadway building in New York City proclaimed the virtues of Dewar's Scotch Whiskey. A quartette of kilted Scots doing the Highland Fling made an appearance in this historic subject.

The notion that motion pictures were solely intended for the amazement and amusement of a cinema-struck public easily persisted through the following decade. The first commercial sponsor to deal with the medium realistically is the bicycle manufacturer (Columbia) who filmed a cycle race in Central Park to earn a place in history as the first sponsor of the product film.

Not until 1911 was the first feature-length film program announced. It was International Harvester who began a thirty-year career in the use of motion pictures and other visual media with the production in that year of a 30-minute film *Back to the Old Farm.* Beverly Bayne, a famous screen heroine of the time, played a leading role in this narrative of farm life. Its plot related the farm boy's flight to the big city to escape the drudgery of the old-fashioned farm, a return visit to the scenes of childhood and behold—the miracle of power farming and inside plumbing has been wrought! The boy-meets-girl fade-out was as popular then as it is now. Today Harvester is showing a complete program of motion pictures, including demonstrations of its equipment in action on farm projects, at annual Power Farming Entertainments which cater to millions of farm people throughout the rural market. In keeping with the times, the company's latest film productions are appropriately titled *The Strong Shall Be Free* (showing the manufacture of war materials in company plants) and *The Marines Have Landed* (showing the use of Harvester equipment by members of the armed services in action).

But the first development of visual media as something more than entertainment dates

back to the era of John Patterson, founder of the National Cash Register Company. In the educational field, George Eastman contributed a large portion of the resources of the Eastman Kodak Company to the production of a library of educational motion pictures. Mr. Patterson, however, used visual media in sales training technic. In that era, another familiar device was the "factory run-around" which simply presented a photographic record of an industrial plant interior, mostly for the satisfaction of the proud owner. This was sometimes altered, if not improved, by a personal appearance by the sponsor himself.

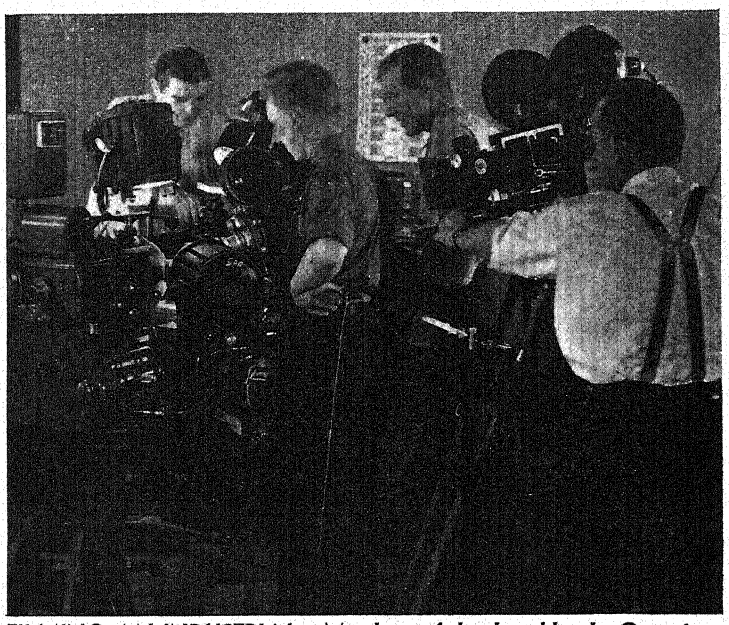
Today's widespread development of the medium within several thousand industrial and business organizations was stimulated by two important factors: the widespread adoption of motion picture instruction and dealer promotion by the automobile industry and, secondly, by the development of the 16mm sound motion picture projector. The first influenced other industries and created a group of experienced producers serving this industry and the second made it possible for an increasing number of business organizations to share the benefits of visual selling with their ever-increasing dealer organizations. Safety film which removed the limitations of booth operation and the hazards of shipment, etc. (imposed by inflammable nitrate product) was another influencing factor in this swift growth.

Still another important element was the invention of the simple filmstrip projector. This device, utilizing a strip of 35mm film on which a series of different still pictures are printed, eliminated more cumbersome lantern slide equipment. To this simple unit, the industry added a phonograph turntable which played a synchronized record of speech and music keyed to the scenes which it accompanied. A deservedly high degree of audience interest is noticeable (see article on *Filmstrips*).

TRENDS IN TRAINING FILMS

A good many institutional and industrial motion pictures were produced to improve the art of selling in the automobile industry. That development and the tremendous change which took place in this same industry in the fall of 1941 serve to highlight a new era which has just begun. Just as the motion picture industry in Hollywood has recently discovered its serious lack of knowledge concerning audience habits, etc., so the industrial film producer has served a restricted field of sales-minded clients.

The era of super-salesmanship as well as of advertising-to-sell was suspended "for the duration" on December 7, 1941. In reality it continues in the field of industrial and institutional films, for today's challenge is even greater. With neither goods nor services to provide, industries engaged in war production must hold customer interest and brand recognition. The film, presenting a pictorial review of the industrial's war activities within the prescribed limits of War and Navy department regulations, serves public relations in this and similar ways.



FILMING AN INDUSTRIAL. Members of the Jam Handy Organization are shown preparing to film a close-up of an industrial operation

But the development of the motion picture and other visual aids as an aid to production training is the most significant development of the new era. The farthest steps yet taken in this and any other direction with relation to either industry or education was that announced in 1941 by the United States Office of Education. Forty-seven pictures on machine shop work and the specialized technics of shipbuilding were contracted for among industrial film producers. In the first three months of sale following the issuance of the first thirty-three subjects, approximately 10,000 titles were sold to vocational schools, industrial plants, and shipyards as a direct aid to the war training program. The event was historic in several ways: it marked a new record in all the history of educational motion pictures; the production of industrial training subjects for educational distribution served to bridge a gap between the schools and industry; and, finally, the program provided the government with the greatest bargain in motion picture production it had ever encountered.

The pictures cost approximately $4,000 to $5,000 per subject or a total of approximately $220,000 for all titles. A single production has on occasion cost the government half that amount in salaries and upkeep alone. The prints are disposed of on a non-profit basis through a commercial distribution organization.

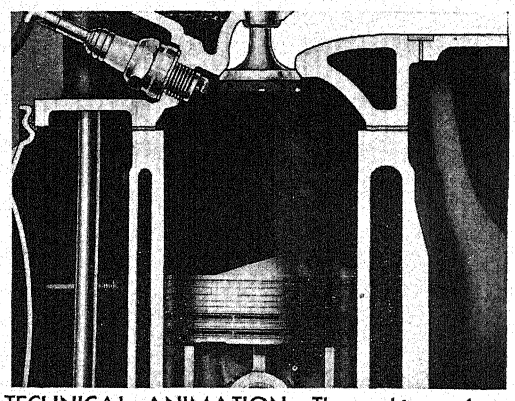
Similar training films are being produced by industry itself. A series of twenty-six sound and silent slide films are in production by the Curtiss-Wright Corporation for the training of technicians in the maintenance and repair of its electrically-controlled variable pitch propellers. The 500 working parts of a modern airplane propeller will serve to show the complicated tasks which face the industrial worker and Army technician and the consequent need for improved training materials which only visual media can adequately provide.

TIME AND MOTION STUDY

One excellent example of the superiority of films for visual training tasks is embodied in the time and motion study field. As Allan H. Mogenson, one of the outstanding experts in this field, describes this new and interesting technic:

"The motion picture is used in two ways in connection with Work Simplification training programs. The first and most obvious use is that of the 'before and after' picture to teach fundamentals to all concerned. These films show the former way of doing a simple operation and then demonstrate the new and easier way of performing it.

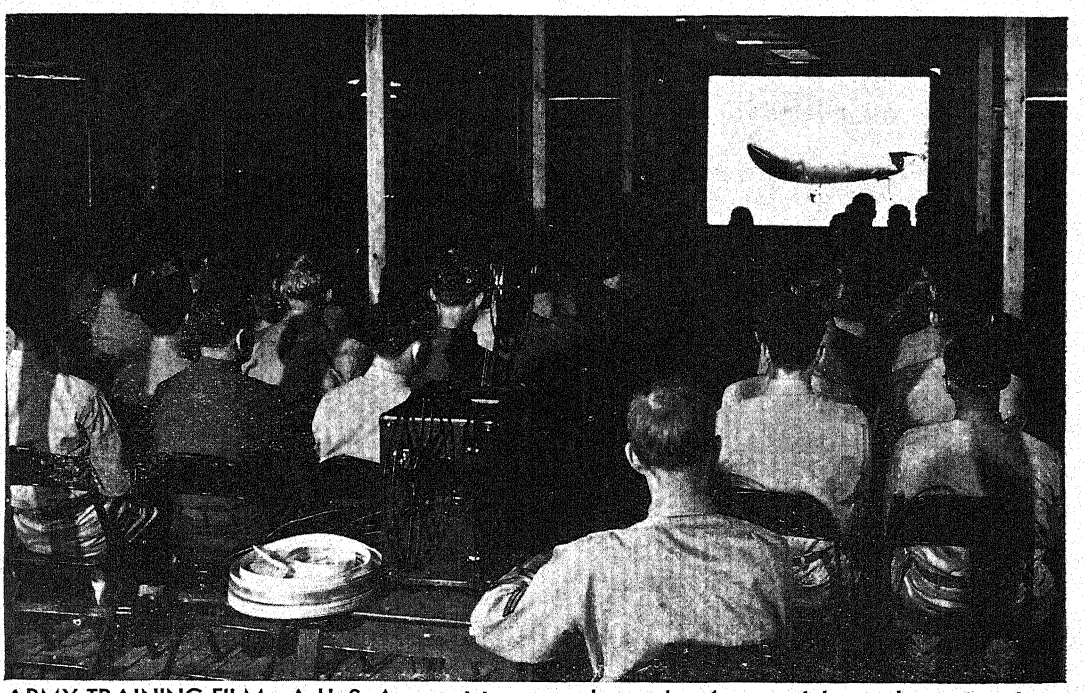
"Each one of these films illustrates a fundamental principle in Work Simplification or



TECHNICAL ANIMATION. The workings of an internal combustion engine are explained by a cut-out animation of parts



THE MILLING MACHINE. Three scenes from the U. S. Office of Education machine shop operation series, produced by Caravel Films, Inc. Such instruction films exist for many other fields and operations. Left to right: the milling machine, cutting a keyway on the end of a finished shaft, and straddle milling



ARMY TRAINING FILM. A U. S. Army training camp class gathers for one of the regular motion picture showings of films produced by Signal Corps

Motion Study and then enables the person who has seen the film to analyze his own operation and apply the same principles to its simplification.

"The use of this particular method can best be illustrated by citing the procedure used in training operators in a new defense plant recently set up in the Middle West. First of all the operation was filmed completely from start to finish in 16mm. This picture ran about 4,000 feet when edited and titled. A small group of engineers looked at the film and of each operation and asked, 'Is there a better way?'

"This analysis occupied the time of the new plant manager and an industrial engineer for just about a week. At the end of this time it was evident that the specifications set forth by the government demanded about twice the equipment that was actually necessary, showed that the new plant could be erected with about half the floor space called for in the government specifications, and that only half the number of people would be required. It can be seen that this greatly simplified the problem of procuring machinery, as well as the problem of training operators."

OTHER WAR TRENDS

The most outstanding development in the industry is the rapid expansion of visual aids used within the armed forces and by the various government informational agencies. The reasons cited by the War Department will serve to illustrate the usefulness of the medium for the same tasks in industry, visual education, and other fields:

(1) Films concentrate attention on essentials by showing only the basic action or subject.

(2) They bring demonstrations of tactical exercises or equipment to the troops, thus eliminating the time-consuming factor of moving troops to the demonstration areas.

(3) The same demonstration can be shown repeatedly without expending the time and labor required to repeat such demonstrations.

(4) Films on the use and care of new equipment can be shown in advance of its arrival, thus facilitating its immediate use.

(5) Instruction for all troop units is standardized.

(6) Mechanical functioning of weapons or motors can be clearly depicted by means of slow motion and animation.

(7) All members of the class can see and hear all phases of an action which otherwise can

be observed satisfactorily only by those close to the scene.

(8) The services of the most highly trained troops and expert instructors are utilized in demonstrating the methods and technics illustrated on the film. This insures that all troops, regardless of location, have constant visual access to the latest approved methods as a standard in attaining training objectives.

The other U. S. Government agencies utilizing the medium extensively are the Office of Government Reports, the Office of



VISION FOR DEFENSE. Produced by the Educational Division of Paramount Pictures, for the Better Vision Institute

the Coordinator of Inter-American Affairs, and the Coordinator of Information. The U. S. Department of Agriculture is one of the oldest government agencies employing the film medium. A complete laboratory and production studio is maintained in a special building within the Department structures in Washington. The Department of Interior has a similar department on a much smaller scale. Similarly the Bureau of Mines, the Archives, and the Office of Emergency Management have film activities. All of these agencies have a single purpose, not far removed from that of the industrial or commercial sponsor: they are *selling* ideas if not actual products by the use of the screen. This present phase of widespread film production in government may well be the outstanding influence on a great post-war development.

COMMERCIAL TECHNIC

A brief review of the commercial film industry and a few of its recent "successes" will serve to explain the present development of the industry.

Production centers in New York, Detroit, Chicago, and Hollywood. In the latter case, it simply follows the path of least resistance and production exists there to serve a Pacific Coast clientele as well as to take advantage of the entertainment industry's superb equipment for national accounts. Detroit is really the commercial capitol of long-standing with several of the largest producers maintaining good-sized organizations developed for the automotive industry which all served. In the entire country there are approximately twenty financially responsible studios, capable of producing feature-length commercial films without outside financing.

Color was being widely employed in some productions prior to the outbreak of war. The industry used Kodachrome heavily in direct 16mm exteriors for the railroads and similar travelogs, but depended on 35mm Technicolor for feature subjects, especially when the script called for product identification or interiors. 35mm cameras, principally the Mitchell, are standard studio equipment with both Western Electric and RCA Sound Systems in the recognized commercial studios. 16mm equipment would have meant little saving to the professional producer and a considerable loss in production effectiveness by lack of optical effects, etc.

The producer answered those who put forth the claim of production economy in the use of 16mm with the realistic suggestion that it was the material put before the camera—the settings, actors, backgrounds, and locations called for by the script to depict the sponsor's story—that determined the cost of the picture. The slight differential between the cost of 16mm and 35mm negative stock and the comparatively low cost of the Kodak Special as opposed to the Mitchell would not account for cost differences.

THE AUDIENCE COUNTS

The industry is obliged to remember that its productions—like that of the entertainment field—are only as good as the audience that sees them. Reaching the American public with non-theatrical programs is a business in itself. These two general methods prevail:

1. *The deposit library:* to which owners of 16mm projection equipment address lending requests for cataloged industrial subjects, sent free on payment of express charges.

2. *The projection service:* in which film, projector, and operator are provided by appointment to appear before luncheon clubs, church groups, schools, and other organizations selected as the audience desired by the sponsor.

In this group-minded land of ours, the audience is nearly always waiting for the next film release. One service lists 56,000 American Legion posts, parent-teacher organizations, fraternal societies, women's clubs, foremen's clubs, and other adult organizations.

Mass audiences may be reached with direct selling messages through the theaters. This is the medium of screen advertising in which minute-length playlets are shown between entertainment films, usually in the neighborhood theater. Nearly 10,000 theaters are available of the 15,000 now operating. Such sponsors as Shell Oil, Canada Dry, American Tobacco, and Alka-Seltzer have made widespread use of this direct medium.

A SUMMARY OF OBJECTIVES

These are some of the present objectives of institutional and industrial films:

1. To explain the role of the manufacturer in production
2. To inform the consumer of changes in materials and services and to encourage nutrition and public health programs
3. Training the dealer organization for duties, maintenance, and repair
4. Explaining the operation and maintenance of equipment furnished to the U. S. Army and Navy
5. Maintaining direct advertising to selected markets

In the technic of production, in the scope of its equipment and personnel, the industrial film appears ready to step into the parts apparently created for it in the war era. The influence of the war era upon it, in widening the recognition of the value of visual education among those in the Army and Navy, the development of additional skilled personnel now engaged in such work, the development of new and essential uses for the medium in the field of war production plant training, industrial morale and relations, and Government information—all these are factors bringing the industrial film into a limelight of deserving recognition which thirty years of constant progress has at long last realized for it.

INTENSIFICATION

Robert Taft, Ph.D.

Professor of Chemistry, University of Kansas; Author of Photography and the American Scene

Negatives which are underdeveloped or overexposed may be intensified through after-treatment and a distinct improvement in contrast will be the result. Given here are formulas and methods for intensification with chromium . . . mercury . . . uranium . . . lead and copper . . . silver. Also local intensification and intensification of positive prints.

All illustrations by Oren Bingham.

See Also Chemistry of Photography, Reduction and Reducers

INTENSIFICATION is the treatment given a thin negative, or a negative otherwise lacking in contrast, whereby better printing quality is secured. Negatives underdeveloped or negatives lacking in contrast because of overexposure can be materially improved by intensification; it is also possible to get more out of an underexposed negative by intensification. Obviously no chemical treatment, however, can supply detail lacking through underexposure.

In most processes of intensification the black silver image present in the negative is first converted into a lighter colored silver salt (i.e., bleached) and the salt is then converted into a substance which transmits less light (i.e., the negative is darkened) than did the original negative. The process of intensification, therefore, consists essentially in making the negative more opaque, that is, more dense than it was originally. The increased density, in an ideal case, should be added so that it is a constant fraction of that already present in both highlights and shadows. Such increase in density will produce an intensified negative possessing the same gradations as the original negative.

In making an intelligent selection of an intensifier, the following points should be kept in mind: 1) availability of materials used in the intensifier and its convenience of use;

2) effect of the intensifier on the graininess of the negative; 3) the stability of the intensified negative; 4) the changes of contrast produced by the intensifier. It should also be kept in mind that intensifiers will increase or intensify any fog present in the original negative. If the fixing bath used in the initial processing of the negative was not perfectly fresh, traces of silver compounds will be left in the gelatin. Although not noticeable to the eye, traces of such deposits will be built into areas of greater opacity in the intensification process. If present throughout the gelatin, intensification will produce a greatly increased and general fog; if present locally, patches of stain will be produced. For this reason, unless it is known that the original negative has been thoroughly fixed, it is best to soak the negative before intensification in fresh hypo. After re-fixing, the hypo should be removed by washing the negative in water. Most intensifiers demand the complete absence of hypo in order to secure the best results.*

INTENSIFICATION WITH CHROMIUM

This process is one of the most widely used methods of intensification. It is convenient, the materials are easily available, the image produced is permanent, and but little increase in grain size results from its use. Very little falsification of the gradations in the original negative results from its use, and the degree of intensification can be increased to almost any desired value by repeating the process as many times as may be necessary.

The process consists essentially in bleaching the silver image originally present by an acid solution of potassium dichromate, thus producing silver-chromium compounds in place of the original silver. When the bleached image is placed in an ordinary developer, the silver and chromium compounds are converted in part into metallic silver and chromium, which transmit less light than did the original silver. The intensifier is prepared as follows:

	Avoirdupois	*Metric*
Potassium dichromate	10 ounces	80 grams
Hydrochloric acid, c.p.	7½ ounces	60 cc
Water to make	1 gallon	1 liter

In use, take 1 part of the above stock solution and dilute with nine parts of water. The negative is bleached until the black silver image disappears (½ to 3 minutes) and it is then washed in water until all traces of the dichromate are removed, i.e., until all yellow color disappears. The bleached negative is then redeveloped in a non-staining developer, amidol being the best for this purpose.* Fixing is not absolutely necessary, but somewhat better results are secured by following the re-development with a five-minute immersion in hypo and then thoroughly washing the negative in water.

The entire process may be carried out in ordinary light. Increased intensification may be secured by: 1) prolonging development; 2) repeating the entire process, although upon each repetition the fractional increase in intensification becomes smaller; 3) by varying the amounts of dichromate and acid in the original bleaching bath. The greatest intensification is secured with small amounts of these two substances. Experimentally it has been found that maximum intensification is secured when 2 cc of hydrochloric acid and 10 grams of potassium dichromate are present per liter of solution in the actual fixing bath.

INTENSIFICATION BY MERCURY

Most mercuric compounds, when dissolved in water, will convert the black photographic image to one transparent to the eye but one which is actually more opaque to the light rays producing photographic action.

*In addition to re-fixing a negative to be intensified, it is also well to harden it before the intensification (to prevent excessive softening and frilling of the gelatin). Both the hardening and fixation may be accomplished by the following procedure. Immerse the negative for 3 minutes in the following bath:

	Avoirdupois	*Metric*
Formalin (37% formaldehyde solution)	2½ dram	10 cc
Sodium carbonate, dessicated	73 grains	5 grams
Water to make	32 ounces	1 liter

After treatment in this hardening bath, the negative is placed in a *fresh* acid fixing bath for five minutes and is then most *thoroughly* washed with water.

*Amidol developer solutions should be used within a few hours of mixing, as oxidation is rapid.

AMIDOL DEVELOPER

(*The Photographic Process*, Mack and Martin)

Water to make	1 liter
Amidol (diaminophenol)	5.0 gm
Sodium sulfite, anhydrous	26 gm
For prints and slides add:	
Potassium bromide	1.6 gm

Develop for about twice as long as the average M-Q developer (D-72).

Advantage is taken of this fact in producing at least two commonly used intensifiers.

Mercuric Bromide Intensifier. The intensifier is prepared as follows:

	Avoirdupois	*Metric*
Potassium bromide	3 ounces	22.5 grams
Mercuric chloride	3 ounces	22.5 grams
Water to make	1 gallon	1 liter

Care should be taken in using the mercuric chloride, and the resulting solution of mercuric bromide, as they are both *extremely poisonous*.

The negative to be intensified is covered with some of the above solution and allowed to bleach until the black image completely disappears. It is essential that the negative be free from hypo or stains will result. After bleaching, the negative is thoroughly washed in water and re-developed. Several redeveloping solutions can be employed, nearly all of which produce images of uncertain stability. Increased graininess also usually results from such intensification and a change in contrasts is generally produced. If high contrast is desired, as in black and white line work, a suitable developer for the bleached negative is the following one:

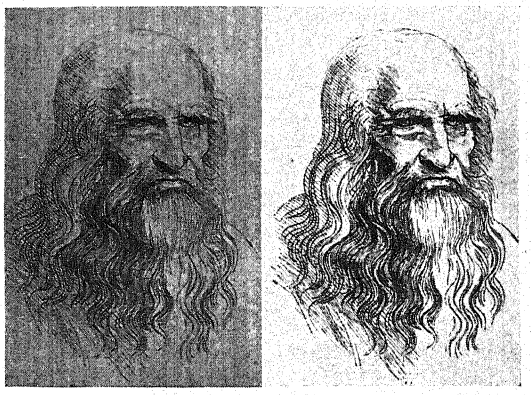
	Avoirdupois	*Metric*
Potassium cyanide*	3 ounces	23 grams
Silver nitrate	3 ounces	23 grams
Water to make	1 gallon	1 liter

*Sodium cyanide may be used in place of potassium cyanide. Both are *violent poisons*.

The cyanide and silver nitrate are dissolved separately in small quantities of water. The silver solution is added to the cyanide solution until a permanent precipitate is just formed. Allow the mixed solutions to stand half an hour, filter to remove the precipitate formed, dilute with water as indicated by the above formula, and the developer is ready for use. After development, the intensified negative should be thoroughly washed in water.

The bleached negative may also be blackened (i.e., re-developed) with either a ten per cent solution of sodium sulfite or with a water solution of ammonia (commercial 28% ammonia diluted with twenty-four volumes of water is satisfactory). The intensified images are not very stable, but press photographers apparently prefer these methods of intensification.

Mercuric Iodide Intensifier. Mercuric iodide as an intensifier possesses an advantage over both mercuric chloride and bromide, in that the presence of hypo in the negative does not produce stains. In fact, a negative may be removed from the fixing bath, washed for a few minutes in water, and can then be placed directly in the mercuric iodide bleaching bath. The bath is prepared as follows:



Intensification of the negative by mercuric iodide intensifier. The photo of a line drawing at the left lacks contrast and would not be suitable for reproduction; after treatment, the negative yields a good print, as shown at right

	Avoirdupois	*Metric*
A. Mercuric chloride	175 grains	40 grams
Water	10 ounces	1 liter
B. Potassium iodide	1 ounce	100 grams
Water	10 ounces	1000 cc

Add most of solution *B* to solution *A* and stir well. Then add the remainder of the potassium iodide (solution *B*) in small quantities until the solution becomes permanently clear; it is then ready for use.

The negative, when placed in this bath, becomes brown to yellow in color. Washing, which follows the use of this bath, usually produces additional changes in color; frequently the negative becomes orange. The washed yellow or orange negative may be dried and prints made directly, as the mercuric iodide treatment has increased the opacity of the image. Still further intensification may be secured by re-developing the negative in a non-staining developer such as amidol or metol-hydroquinone.

The mercuric iodide intensifier is stable, keeps indefinitely, and works very quickly and cleanly. It is especially useful for local intensification. Considerable increase in grain size results from its use, however.

URANIUM INTENSIFIER

This substance is the best builder of detail of any intensifier; detail that is scarcely perceptible to the eye in an underexposed negative can be built up, by its use, into printable densities. The solution is stable and can be used repeatedly, but greater care in its use is necessary than in some other intensifiers, and it is difficult to tell by the eye the proper stage of intensification. The last difficulty is due to the fact that the uranium intensifier converts the black silver image into one which varies from reddish brown to bright red; this resultant image stops the light more effectively photographically than it does visually. The negative to be intensified by this process must be free from hypo and, further, the wash water used after intensification must be free from hardness or alkalinity. If these conditions are not met, irregular staining of the intensified negative will result. The formula:

	Avoirdupois	*Metric*
Solution A		
Uranium nitrate	120 grains	25 grams
Water to make	10 ounces	1 liter
Solution B		
Potassium ferricyanide	120 grains	25 grams
Water to make	10 ounces	1 liter

The above solutions may be mixed and glacial acetic acid added in the ratio of 8 volumes of the mixture to one of the acid, but better keeping qualities are secured by keeping the stock solutions separately and mixing 10 parts of solution *A*, 10 parts of solution *B*, and 2.5 parts of glacial acetic acid just before use.

The negative is immersed in this solution until intensification is judged to be complete, which, as inferred above, will require some practice with this bath. After intensification is finished, the negative is washed in water *free from hardness and alkali* (i.e., distilled water) and dried.

The intensification produced by uranium may be removed by washing in dilute ammonia or sodium carbonate solution. If the red image is removed and it is desired to reintensify the negative, it should be bathed in a weak solution of acetic acid to neutralize any alkali remaining from the ammonia or sodium carbonate treatment.

INTENSIFICATION WITH LEAD OR COPPER

Extreme intensification may be produced by these two intensifiers; they are therefore used primarily for line work. The lead intensifier is made as follows:

	Avoirdupois	*Metric*
Lead nitrate	200 grains	41.6 grams
Potassium ferricyanide	300 grains	62 grams
Acetic acid, glacial	1½ drams	20 cc
Water to make	10 ounces	1 liter

The negative is bleached in the above solution, washed in water, and then given a short immersion in 10 per cent nitric acid. Care must be taken in handling the negative in the acid solution, as the film becomes soft in the acid bath. Wash again in water and darken in a solution containing:

	Avoirdupois	*Metric*
Sodium sulfide	1 ounce	50 grams
Water to make	20 ounces	1 liter

The copper intensifier may be prepared as follows:

	Avoirdupois	*Metric*
Solution A		
Copper sulfate (blue vitriol)	100 grains	208 grams
Water to make	1 ounce	1 liter
Solution B		
Potassium bromide	100 grains	208 grams
Water to make	1 ounce	1 liter

The rate of solution of copper sulfate may be hastened by dissolving it in hot water. When cool, mix equal volumes of solutions *A* and *B* for use.

The negative is bleached for several minutes in the mixture, washed in water, and then darkened in a solution consisting of:

	Avoirdupois	*Metric*
Silver nitrate	45 grains	100 grams
Water to make	1 ounce	1 liter

If too dense an image results from this treatment it may be reduced in a weak solution of hypo (10 grains to the ounce). The image produced by the copper intensification is not permanent.

SILVER INTENSIFIER

This intensifier, although somewhat more difficult to prepare and use, is in many respects the best of all. Proportional intensification of the negative is secured, the intensified image is neutral in color, permanent, and exceedingly fine grained. For these reasons it is especially useful for the intensification of miniature films. Before intensification, the film should be hardened in a formalin bath (see article on *Hardening*). After hardening in this bath for five minutes, the film is removed, washed in water, and is then placed in the intensifying bath prepared as follows:

	Avoirdupois	*Metric*
Solution A		
Silver nitrate	2 ounces	60 grams
Distilled water to make	32 ounces	1 liter

Solution B		
Sodium sulfite, dessicated.	2 ounces	60 grams
Water to make.....	32 ounces	1 liter
Solution C		
Hypo.....	3½ ounces	105 grams
Water to make.....	32 ounces	1 liter
Solution D		
Sodium sulfite, dessicated.	73 grains	5 grams
Elon.....	117 grains	8 grams
Water to make.....	32 ounces	1 liter

The intensifier is mixed just before use from these four stock solutions. The mixture is prepared by slowly adding 1 part of solution *B* to 1 part of solution *A*, stirring thoroughly during the addition. The white solid appearing as the result of this action is dissolved by adding one part of solution *C*. When clear, 3 parts of solution *D* are added with constant stirring.

The mixture is then ready for use. As the mixture is not stable for more than half an hour at room temperature, the negative should be ready for immersion in the intensifier as soon as mixing is complete. The extent of intensification depends upon the time of treatment, but should not exceed 20 minutes. The negative, after intensification, is immersed in a strong solution of plain hypo for three minutes and then washed in water.

If sufficient density is not gained upon the first treatment, the negative may be further intensified by a second treatment. If too great density is secured in the intensification, proportional reducers may be used to diminish the density (see article on *Reduction*).

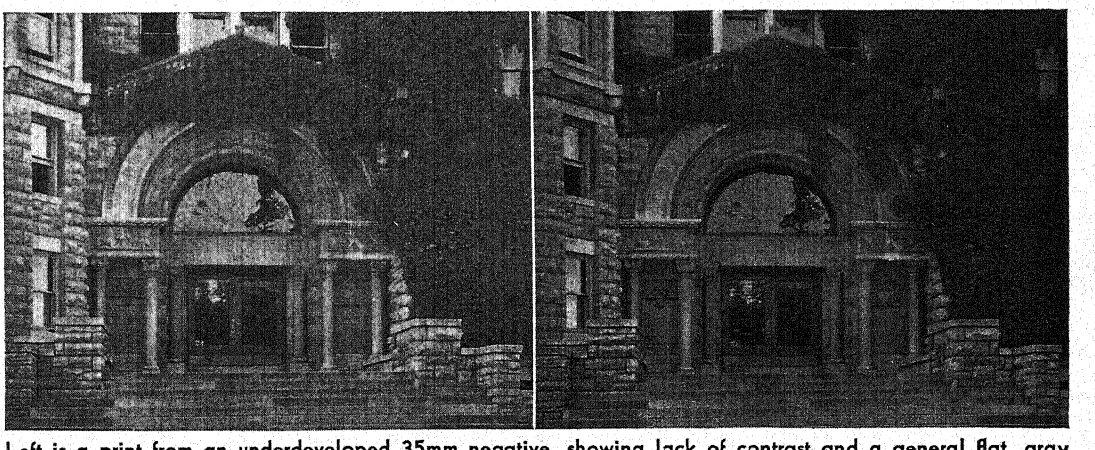
LOCAL INTENSIFICATION

It is sometimes desired to increase the density of faint shadow detail in a negative, and less frequently the detail in highlights. Local treatment, by applying a selected intensifier to such an area with the aid of a small camel's-hair brush or a tuft of cotton, can then be carried out. Gentle application of a dilute intensifier to the area to be strengthened is made, the intensifier allowed to remain for a few seconds, and then wiped off with a viscose sponge. The treatment can be repeated until the desired density is obtained. Local intensification is best carried out on the wet negative. A small bench fitted with a glass plate beneath which is a small light, will be found extremely useful if much of this work is to be done. The wet negative is placed on the glass, illuminated from below, and the intensifier cautiously applied. The mercuric iodide and uranium intensifiers are especially suited for local intensification if used directly and without any subsequent darkening agent. Intensifiers which bleach and darken usually produce fringed spots when applied locally and a single solution intensifier, if used in dilute enough solution, avoids this defect.

Purely mechanical intensification can be applied locally in the form of dilute solutions of opaque dyes. One of the most frequently used dyes for this purpose is erythrosine.

INTENSIFICATION OF POSITIVES

Formerly it was seldom necessary to resort to the trouble of intensifying a print, but the widespread and growing use of the miniature camera has, to some extent, made intensification of prints a process of greater importance. Nearly all intensifiers (with the exception of the silver intensifier) produce some increase in grain size and hence intensifica-



Left is a print from an underdeveloped 35mm negative, showing lack of contrast and a general flat, gray appearance. The print at the right, from the same negative, was intensified with chromium intensifier. This shows the possibilities of intensifying during printing

tion of the miniature negative is not advisable. Further, most intensifiers change the color of the image. As a result, the only satisfactory intensifier for a black and white print is the chromium intensifier. The print is bleached by the use of the same chromium intensifier used for negatives, but it must be thoroughly washed to remove the last traces of the yellow left by the dichromate. The redeveloper used for the print may be the one used in its original development or, preferably, amidol.* The process of intensification may be repeated until the desired density is obtained, but if more than one intensification is made, amidol should be used in redeveloping, as it is less likely to produce frilling and softening of the gelatin emulsion.

*An amidol paper developer is Agfa 113.

INTERIOR LIGHTING FOR MOTION PICTURES

James Wong Howe, A.S.C.

Hollywood Cinematographer, Warner Bros.

Hollywood lighting technics are offered to the amateur in this informative article by one of the most distinguished cinematographers in the country. Mr. Howe's explanation of key or source lighting offers new opportunities for home movie makers. In addition he tells how to use architectural features of interiors to advantage, how to balance your lights, how to light scenes for dramatic and special effects, and how to build an effective lighting set-up from homemade equipment.

See also Cinematography—Professional, Composition in Motion Pictures, Interior Photography, Lighting For Amateur Movies

IN A PROFESSIONAL FILM, the cinematographer's aim must be to give the audience a feeling that it is looking at real action, taking place in a real room—not at actors going through their paces on a studio set. In the amateur film, there is the parallel task of conveying to the audience the feeling that it is looking at unposed reality rather than at people having their pictures taken.

Lighting plays a vital part in this. It is not enough that the people be attractively set off by suitable portrait lightings; the room behind them must be as attractively and convincingly lighted. And the lighting of the two elements of the shot—people and background—must be so coordinated that the illusion of reality is maintained. In this lies the weakness of many an amateur film. Most amateurs seem to get a quick grasp of the fundamentals of personal lightings. But, except in rare instances, the equally important factor of set lighting escapes them. Sometimes it is ignored completely. Sometimes the background is merely illuminated flatly to a degree sufficient to produce an exposure. In either case, the result is a picture lacking in the vital illusion of reality. The best remedy is to approach the whole problem of lighting from a more professional viewpoint.

With modern sensitive materials, getting enough light to produce an exposure is no longer a consideration. Arranging the lighting so as to produce the desired effects is all-important. In this, the speed of modern film and lenses and the slower shutter speeds of most 16mm and 8mm cameras are distinct assets. They not only permit the use of less light and smaller units, but they make it possible for the movie maker to divide his light into smaller packages. He can use smaller lamps and more of them. Moreover, with the modern "dinky" spotlights, he can now utilize in greater profusion the controllable beams of such units as the professional does, for true precision spotlighting.

The keynote of any lighting set-up—professional or amateur—must naturally be the people being photographed. This, in turn, will be governed by the familiar canons of good portrait modeling, by the particular photographic requirements of the people involved, and by the physical requirements of the action.

The lighting of the background—set or room—must be coordinated with this, for both are component parts of the same basic unit, the scene itself. For good cinematography, we cannot tolerate expertly-lighted people and carelessly-lighted sets, or vice versa.

THE KEY LIGHTING METHOD

The present generally accepted technic of professional motion picture lighting is the so-called "key light" or "source lighting" method. In this, the whole lighting scheme is correlated with some logical, natural source of light, so that the resultant lighting appears natural and unstudied.

Simulated Effects. For example, suppose we have a day-effect interior scene played in a room on one wall of which are large studio windows. In reality, we would expect the majority of the illumination of such a room to come from those windows. In lighting the set, we arrange the lighting so that a comparable effect is produced. The strongest sources of light are placed at that side. Such illumination as must necessarily come from other angles should be subordinated to this key light, and serve principally to fill in shadows and produce necessary effects of modeling and relief.

In a night-effect interior, we might similarly plan our key lighting source to simulate the effect of some light source, such as a chandelier, a reading lamp, or the like.

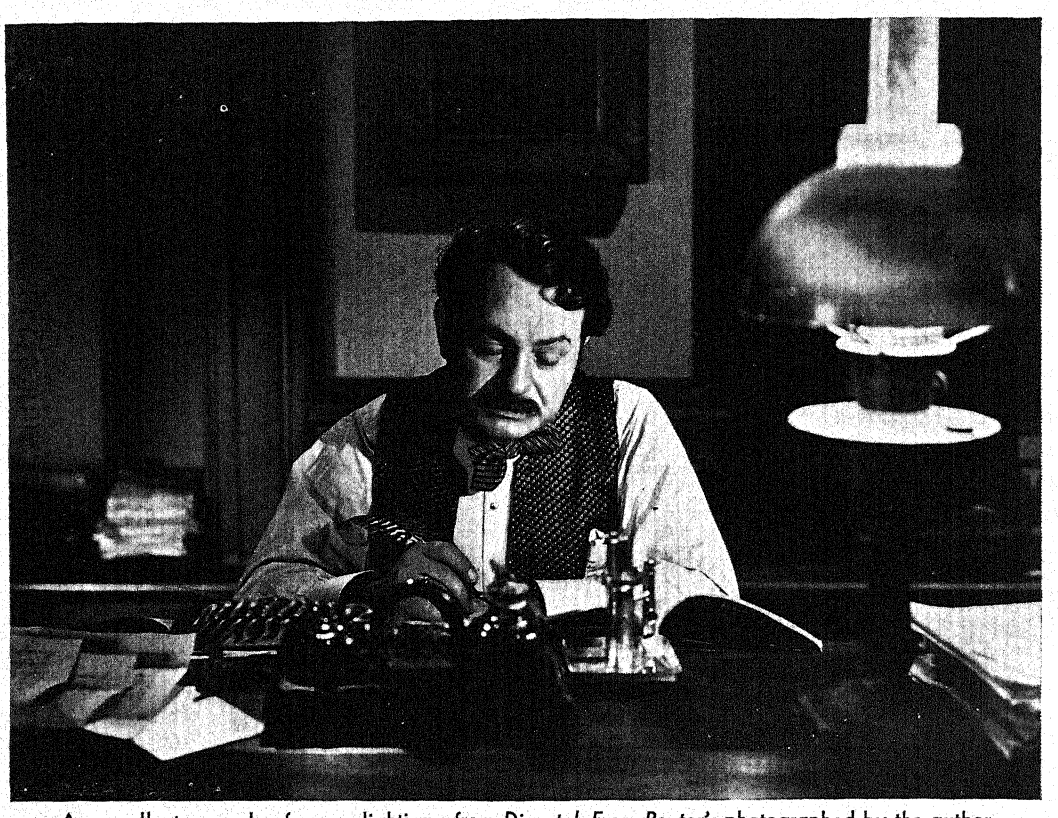
Lighting a room or set that evidences any particular degree of depth, skillful lighting can enhance the illusion of depth often to a degree that is startlingly three-dimensional, despite the camera's one-eyed perspective. After all, lighting—as opposed to mere illumination—is a matter of arranging highlights and shadows to create an illusion of depth.

Reenforcing Natural Light. Very often the key can be found in the visual impression given by the room under its natural lighting. Study this and notice where the highlight areas and the intervening shadow areas actually fall. Then duplicate the effect with lamps of sufficient power to give you the necessary exposure level for your picture making.

Frequently this can be done by simply using your photographic lamps to illuminate the areas in which the people will perform their most significant actions, and taking care of the other natural highlight areas in the room by merely screwing photofloods



Normal interior lighting—the average illumination of a home living room, for instance—cannot be used for a movie interior. But this lighting should be convincing, with the illusion of reality. In this scene from *Yankee Doodle Dandy,* for which the author was cinematographer, notice that the back wall has interest and depth, and that the actors are, at the same time, given a well-lighted room in which to move around
Photo from Warner Bros.



An excellent example of source lighting—from *Dispatch From Reuter's* photographed by the author
Photo from Warner Bros.

into the normal lighting fixtures. These, naturally, should either be reading lamps fitted with shades that shield the camera's lens from their direct rays, or in positions such that they will not shine directly into the lens.

Filter Lights. The above will probably produce a more or less "spotty" lighting, with highlight areas around the table and reading lamps, and shadows of varying depth between them. Basically, this is the natural effect; it is more to be courted than feared. However—especially with the narrowed latitude of modern super-speed films—these intervening shadows may sometimes be too deep. It is therefore necessary at times to fill in these shadow areas with soft illumination. This filler light should not be enough to wash out the shadow, but sufficient merely to make it luminous, yet still an evident shadow. In general such shadow areas, if measured separately with a light meter, should reflect about one-half or one-third as much light as the highlights. The filler light, too, should preferably be well diffused; it should appear only as general illumination. It should never appear to come from any specific source.

SEPARATING PLANES

This type of lighting will, if properly applied, give a natural separation of planes through tonal and lighting contrast. This is particularly effective in shots in which a character moves across or through the different lighting planes. As he passes from a highlight area into a shadow area, and again into an adjacent highlight area, the audience feels consciously that he has gotten somewhere, for it is a natural lighting effect to which they are accustomed through actually seeing a person walk across a normally-lighted room.

A very effective application of this trick is in extreme long shots through a series of rooms opening from each other. One room can be more strongly illuminated than the next, and so on. Doors through walls

shown in the shot can be open, with streams of light coming through them from the rooms beyond, even though these latter rooms may not actually be shown in the scene. The trick is inevitably an asset when shooting down a long, narrow hallway—a difficult lighting problem if tackled by ordinary amateur methods. If such a corridor is lighted in the ordinary amateur way, it will either photograph flatly, with about as much pictorial attractiveness as a hospital corridor, or it will show a strongly-lit foreground, fading off into underexposure in the more distant regions where the light from the foreground lamps does not penetrate. But with beams of light coming in from the rooms opening off that hallway, nicely spaced by natural shadow areas, the picture at once gives an impression of length. At the same time, it becomes more interesting to look at.

In planning such lighting, it is generally best to coordinate the lighting with the action so that the plane in which the actors perform their most significant actions will be the plane of strongest illumination, thereby concentrating attention on the action occurring there.

In lighting more routine shots in rooms, there are countless little tricks of lighting which can be used to produce illusions of natural depth, roundness, and reality. For example, curved surfaces of walls, pillars, or even the legs of furniture can be cross-lighted, producing little catch lights which heighten the effect of natural roundness.

NIGHT INTERIOR SCENES

In night interior scenes, added realism is given by having the regular globes in wall fixtures, chandeliers, and the like that are shown in the scene actually turned on. Using the relatively low-powered globes commonly used in such fixtures, their light "picks up" on the film, without causing undue halation. This is of course especially true with the frosted amber and flame-colored globes so often used in these fixtures.

Often, except with the fastest films, these globes will not radiate enough light to produce photographically the spot of light on the surrounding wall, etc., that we ordinarily see visually. This effect can be very easily produced, however, by placing the diffused beam of an appropriate floodlight or, better, a spotlight where it will do the trick.

ARCHITECTURAL AIDS

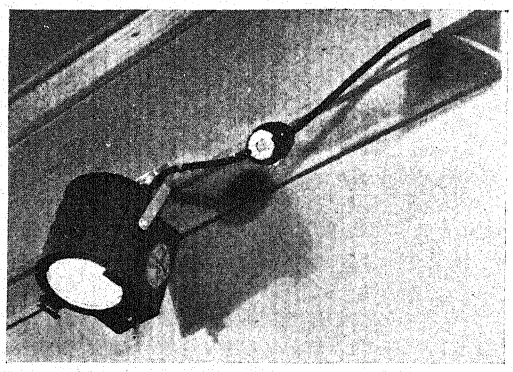
The amateur cinematographer, like the professional, should be constantly on the alert for architectural irregularities in wall surfaces of which he can take advantage in



A medium shot from the Warner Bros. production, *Dispatch From Reuter's*, photographed by the author. Note the use of highlights and shadows to give some dramatic qualities to the scene and to give roundness and depth to the background. The cast shadows of the window frames make an interesting lighting device, too

lighting. If flatly lighted, such irregularities are of no photographic value. But if lighted from one side or the other, or from above, so that they cast shadows in a natural manner, they are invaluable, for the highlight and cast shadow together give the effect of relief.

The modern school of interior decoration which features white or light-toned walls is a distinct asset to the lighting-conscious cinematographer. Flatly lit, these walls can be starkly uninteresting. But they make an ideal screen upon which shadow patterns may be cast. And how those shadow patterns can break up a bare expanse of wall! The shadows of mantels, lighting fixtures, furniture, even of flowers in a vase can be utilized for pictorial advantage, and to make the shot look more real. Notice how this is done in professional films that employ modernistic white-walled sets.



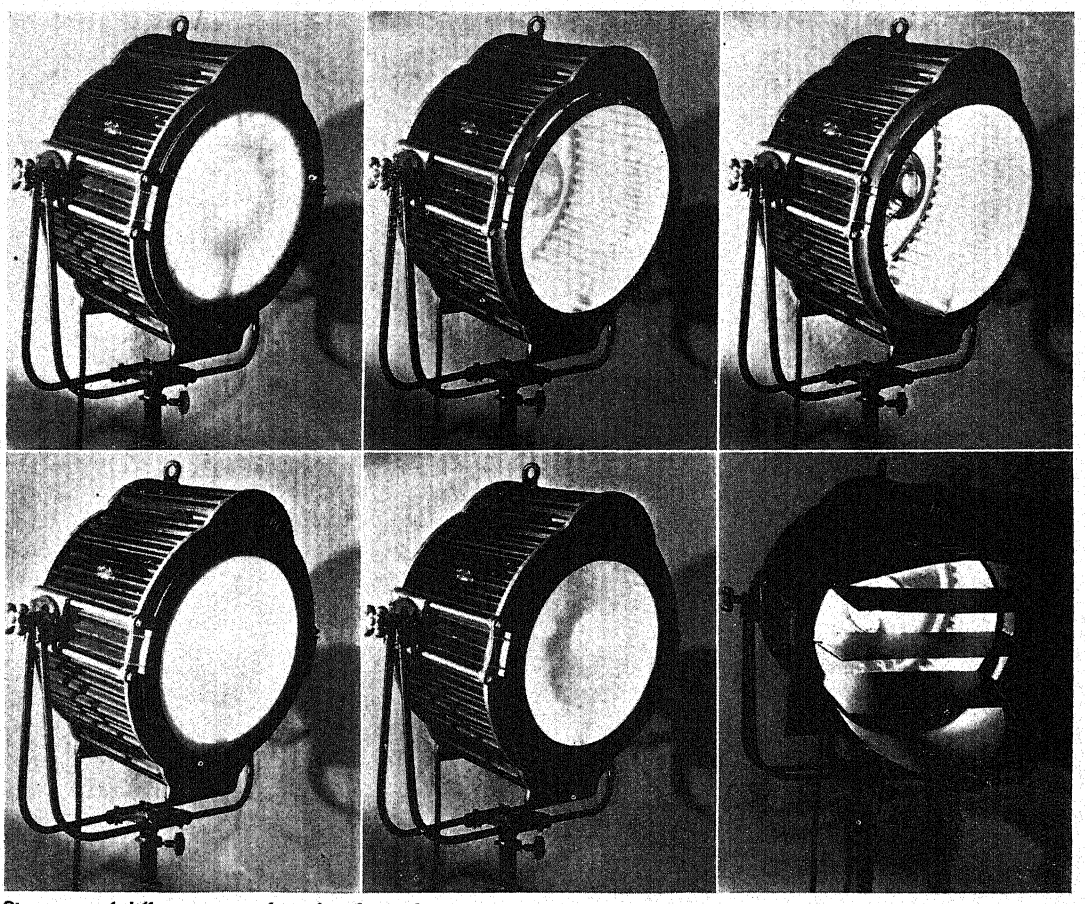
For backlighting in home filming, this "dinky" spotlight may be hung on the molding as shown here

Too frequently the amateur makes the mistake of filming his action too close to walls. The professional is continually fighting to keep the people away from the walls so that he can light both the players and the wall more effectively and secure a greater degree of separation between them.



A still from *Yankee Doodle Dandy*, Warner Bros. production, shows the "dishpan floodlight" used as a prop for a vaudeville backstage scene. A similar light, of adjustable height, may be built by the amateur movie maker

Furniture placed close to a wall is often a problem. Frequently, even though a chair or couch and the wall may be of actually different colors, they will photograph in similar tonal values. As a result, they will tend to blend together into an indistinguishable mass. This can be overcome by lighting. If tonal contrasts are not possible, lighting contrasts are. Light the wall behind the chair more strongly than the chair itself and it will appear lighter in the picture, and the chair will stand out pleasingly. This can usually be done quite easily by hiding a small floodlighting unit behind the chair, with its beam directed upward upon the back wall. At other times, the opposite may be preferable: place the lamp behind the chair, but direct its beam upward and toward the chair, to produce a rim



Six types of diffuser material, as fitted to a Laco studio lamp. From left to right, top row: double white gelatin, gauze net, gauze net with left side cut away; bottom row: silk diffuser, Celoglas, net diffuser with concentrator to keep the light beam from spilling

of backlighting, again effectively separating chair and wall by lighting contrast.

Mouldings around the upper parts of a wall can be invaluable to the home cameraman. Such mouldings can be used as ready-made lamp-rails, and small floodlighting units and particularly the "dinky" spotlights can be hung on them, casting their beams down into the scene wherever they may be needed, to provide backlighting or specific "spot" illumination on set, furniture or players.

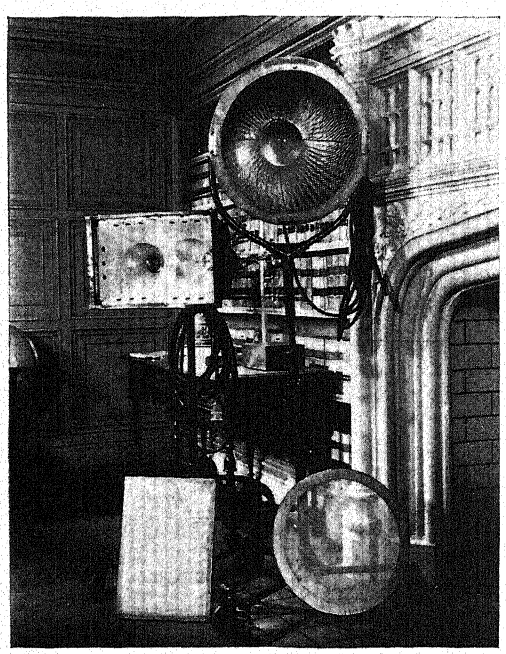
Small units like the "dinkies" can also be used to great effect, hidden actually within the scene. These little lamps can be concealed on a table, behind a pile of books, a vase of flowers, or the like, and can throw their beams in places and directions where no ordinary lamp could reach.

HOMEMADE LIGHTING UNITS AND ACCESSORIES

Homemade lighting units can be most useful in this type of room lighting, making an excellent supplement to the commercially-available photographic floodlighting units, clamp-on photoflood reflectors, "baby spots," and "dinkies." Especially in Kodachrome, where a widespread foundation of general illumination is usually desirable for a foundation, one such homemade unit which can be very valuable as a wide-angle floodlight can be made from an ordinary tin dishpan fitted with sockets for four, six, or more photofloods. Another type, valuable for hiding behind furniture, etc., to light back walls, can be made by mounting a suitable socket on a wooden block and nailing a curved reflector of tin behind it. This sort of unit

can be placed on the floor and use either a photoflood or a tubular projection-type globe. Surprisingly good floodlights can be made by fitting appropriate sockets into discarded aluminum saucepans from which the handles have been removed. These lamps may then be fitted with bushings to be screwed onto your spare tripod, or with clamps for clamp-on use.

A very important accessory is the diffuser. These can be made by fastening to a frame of



Two types of studio floodlights used on Hollywood sets. Notice that both are on rollers, that there is a long and well-insulated wire, and that both have diffusers

plywood or tin, appropriately shaped to fit the lamp with which it is to be used, one or more sheets of white silk, tracing cloth, or oiled gelatin. With some lamps, it may be possible to mount the diffuser by simply tacking the diffusing material to three or four ordinary spring-clip clothespins, which in turn clamp onto the rim of the lamp's reflector. It is important to provide a space of an inch or more between the lamp rim and the diffuser; without this ventilation, the heat from the globe will scorch or burn the diffuser. Ventilation is not so necessary in making diffusers for spotlights, as a well-designed spotlight already provides for ventilation.

Each type of diffusing material has its own optical characteristics. An assortment of several types—silk, tracing cloth, frosted gelatin or cellophane, oiled gelatin, and the like—will provide a startling range of lighting control, even with floodlights. Sometimes two or more diffusers, of similar or dissimilar types, may be used over a single lamp to give precisely the desired quality and intensity of light.

LIGHTING A SIMPLE SET

Application of some of these principles to an actual problem in lighting with amateur equipment is shown in the accompanying illustrations. The general effect is one of complete naturalness. The lady is seated at the piano. There is a fairly strong key light on the left side of her face, ostensibly coming from the table lamp beside her on the piano. The other side of her face is slightly and naturally shadowed. On her hair and shoulders there is a rim of backlighting which apparently comes from the lighted room behind her. On the back wall to the left is a lighted wall fixture, obviously one of a pair. These quite naturally throw pleasing shadows of the mantel, etc., relieving the bare expanse of white. They also provide an apparent source of secondary illumination and throw a splash of light across the folds of the curtain in the doorway, giving an effect of roundness and actuality to the curtain. The room behind is quite brightly illuminated, creating, with the aid of the contrasting dark plane of the curtain and the lighter tones of the foreground room's walls, a useful impression of depth. On the walls of this back room, shadows of the chairs are cast on the white walls, again breaking up an otherwise blank expanse of white wall surface.

Here's how it was put on the screen. The first step is the key light on the lady. Ostensibly, it comes from the table lamp beside her. It might in some instances be possible to have it actually come from that source, by simply screwing a photoflood globe into one of the lamp's sockets. But in this case, the lampshade is such that if this were done it would probably give a harsh, horizontal shadow across the upper part of the subject's face, so we have the key light actually from another source outside the frame. We

put a fairly strong globe (165 watts, in this instance) in the table lamp, and use a 500-watt photographic unit just out of the picture and placed rather high, to supply the actual key light.

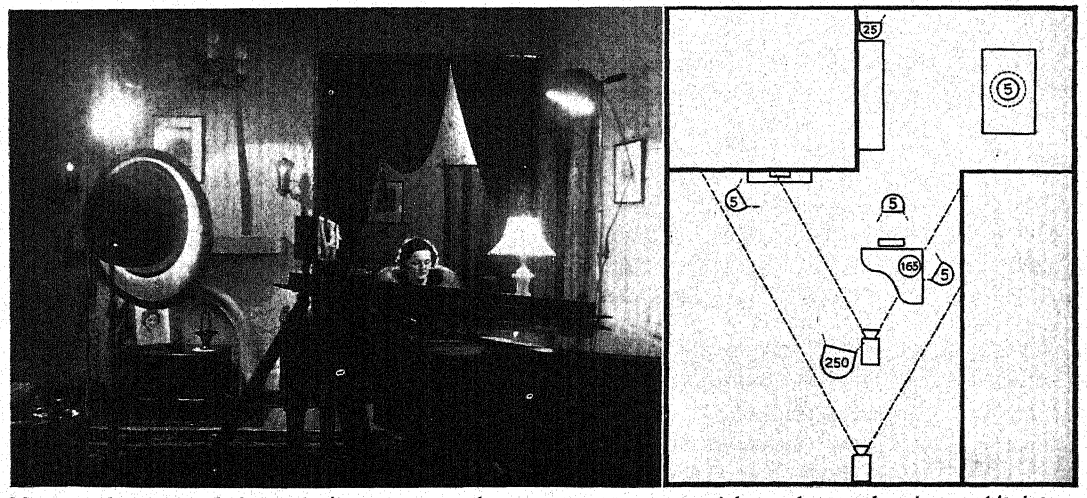
The secondary front light or "filler light" which relieves the shadows on the other side of the subject's face came from a homemade dishpan floodlight fitted with a single 250-watt tubular bulb and a silk diffuser, and placed to the left of and behind the camera, quite a bit removed from the subject. The backlighting, while supposed to come from the lights in the farther room, naturally could not actually do so. Therefore in this shot it came from a second 500-watt photographic lamp placed behind the subject, as low as its stand would permit, and tilted upward.

This takes excellent care of the subject, but as can be readily seen, makes no provision for lighting the rooms behind her. In creating this part of the lighting, the first step was to create the modeling or shadow-casting light on the back wall of the nearer room, to the left of the frame. First, the regular light in the wall fixture was turned on. This picks up enough on the film so that it appears that the lamp shown is actually the source of the light. The light itself really comes from a third 500-watt photographic lamp placed well out of the picture and fairly close to the wall. This lamp was placed as high as its stand would permit, and tilted to give the desired pattern of light and shade on the wall.

The illumination of the far room was provided by simply putting a photoflood in the chandelier, which is fortunately screened from view of the camera by the curtain. This gives a strong flood of general light throughout the room.

To cast the shadows of the chairs on the back room's walls and break up the bare expanse of unrelieved, white wall, another homemade unit is used. This is one made from a simple wooden base, a socket and a sheet of tin about six or eight inches wide by a foot long, nailed to the block to form a U-shaped reflector. A photoflood can be used in this, but for this particular shot a 250-watt tubular globe was used instead. The lamp was placed on the floor, hidden from the camera by the buffet, and arranged to cast the shadows of the chairs on the wall. For this, the chairs were moved a few inches away from the wall.

Thus by adding two lamps and a photoflood screwed into a room lighting fixture to the lighting required to present the subject favorably, the two rooms were lighted effectively and realistically. The same general methods may be applied to virtually any home lighting problem.



Here is a diagram and photo of a home movie making set-up, using some of the professional technics of lighting. A 250-watt "broadside" with diffuser is beside and slightly behind the camera; a 500-watt light is beside the piano, and one is at left, lighting the back wall. A 165-watt bulb is in the lamp on the piano. In the back room a photoflood in the chandelier gives general lighting and a 250-watt tubular bulb supplements it. The illumination level used was for a film with a Weston speed of 16



Soft, heavy shadows are used for tragedy just as a high key lighting is used for comedy. This scene from the Warner Bros. film *King's Row*, photographed by the author, makes full use of dramatic lighting. And notice the feeling of depth given by the indication of a background room

BALANCING YOUR LIGHTS

The most vital single factor in successful lighting is *balance*, maintaining the correct relationship between the illumination of the highlights and shadows so that it is consistently within the reproductive range of film and processing. If the lighting is incorrectly balanced, if there is either too great or too little difference between the illumination of highlights and shadows, no possible trick of exposure or film processing can bring about a satisfactory result.

If the balance is correct, the actual total amount of light used is of secondary importance. Recent surveys of professional lighting levels* show that Hollywood's cinematographers employ light levels which vary as much as 600% between one studio or cinematographer and the next. Yet because the successful professional understands balance, these scenes, made on fundamentally similar film with similar lenses and similar processing, are, despite the great variations in average illumination, of uniformly satisfactory technical quality.

Balancing lighting is an extremely individual matter. It is governed to a great extent by the type of film used, the processing it is to receive, and the effect desired. But even more it is governed by the cameraman's individual methods of lighting; it is a part of his artistic stock in trade. To a degree, it can be checked and measured by taking selective readings with a light meter. But in its finer developments it demands an innate or cultivated feeling for photographic lighting closely akin to the true artist's feeling for composition.

LIGHTING FOR DRAMATIC EFFECTS

When the amateur film begins to emulate the professional and tells stories, yet another factor enters the problem of lighting. This is lighting for mood and dramatic effect. Human emotions respond as readily to visual tones perceived through the eye as they do to musical tones perceived through the ear. And just as certain types of musical harmonies subtly bring to mind certain emotions and emotional reactions, so too do certain visual effects.

Soft, heavy shadows with a limited scale of half-tones and grayed highlights suggest somber tragedy. Deep, heavy shadows sharply contrasted with strong highlights and with a minimum of intermediate tones suggest melodrama. A normal tonal range suggests a normal mood. A high key tonal range, with light, delicate tones predominating and few, if any, heavy shadows suggests happiness and comedy.

Correctly used and interrelated, these visual moods can prepare an audience to be subconsciously receptive to any dramatic mood, even before a character enters or a word is spoken. They must be handled with restraint, however, and with a full appreciation of the cinema's requirement of continuity of lighting. That is, a given scheme of lighting should remain essentially unchanged throughout a sequence. Similarly, except where a sudden, sharp contrast of dramatic moods is intended, every effort should be made to prevent having to intercut scenes of contrasting visual moods. The visio-dramatic contrast is likely to be too

*See *American Cinematographer*, July, 1940, pp. 294-296, "Surveying Major Studio Light Levels," by William Stull, A.S.C.

abrupt otherwise. Occasionally, of course, such contrasts may be deliberately courted, as, for example, the contrast between a somber scene in a dictator's concentration camp and the gilded luxury of the boudoir of the dictator's favorite.

CONCLUSION

Finally, let me say that I personally feel that the question of lighting is generally approached from the wrong angle. Instead of approaching any given set or action with the question "How shall I light this?" I prefer to approach it with the thought, "What compositions can I make with this set and this action?" Then I proceed to make those compositions, and the lighting automatically takes care of itself.

That is about all there is to say about the problem of lighting. Make your composition. Arrange the primary lighting to accentuate whatever may be the salient points of that composition. Arrange the rest of the lighting to display your set and players properly, keeping the tonal key of the picture as high or as low as the mood of the scene may require—and there you have your shot lit! Add to this experience and an understanding and appreciation of the principles of visual art and photography, and the technicalities of lighting are forgotten beside the absorbing interest in the artistic achievement sought.

INTERIORS—HOME AND PROFESSIONAL

F. S. Lincoln
Professional Architectural Photographer

There is a good deal of difference between photographing the home as it is—for a record—and picturing an interior as a special composition. The latter technic is discussed and amply illustrated in this careful article, telling what equipment to use, how to set up the lighting, judge exposure, arrange the interior composition.

All photographs by F. S. Lincoln.

See Also Architectural Photography, House and Home Photography, Interior Lighting For Motion Pictures

PHOTOGRAPHY OF INTERIORS, like any other branch of the camera art, must be practiced to be mastered. A lot of labor and perseverance is necessary to do outstanding commercial work, but much interest and pleasure can be had by amateurs who cannot attempt to equal the results of the professionals who keep themselves constantly occupied and who have better equipment to work with. Equipment, however, in itself, is not as all-important as some people believe it to be. Experience and knowledge count far more than an abundance of the latest apparatus.

Just as we cannot know all the best points about a person at first glance, so we cannot always see the most attractive features of a house or interior without study from various angles under varying conditions of light. In practical photography of interiors, the natural light that enters through the windows and doors is generally unsuitable for showing the features of architecture and decoration to advantage. Consequently if one learns how to use a flood lamp skillfully, his pictures can be immeasurably improved. I have been making interiors for magazine reproduction for many years and *only on rare occasions has no artificial light been used*, even though such use may not be apparent in the finished product.

As in all photography, getting balance and composition is the most difficult part of interior photography. Next is lighting. But lighting, in turn, is a vital part of composition, because a photograph is made up of a combined assortment of light, medium, and dark areas that is more or less pleasing to the eye. Sometimes we can alter the existing tones of the different areas and work for esthetic advantage. For instance, we can substitute a light colored chair for a dark one, change pictures on the wall, or add a picture where none existed before, etc. Generally speaking, however, the less of such shifting around of objects, the less involved and time-consuming is the photographic procedure; but to a trained eye an interior is seldom shot without some juggling of furniture, nick-nacks, etc.

THE CAMERA

Having settled the preliminary discussion of interior photography, what camera is best to use? The average hand camera, whether of the box type or the folding type with bellows and permanently attached lens, is wholly unsuited for architectural photog-

raphy, for the main reason that their lenses are of focal length adapted to the making of portraits, snaps of individuals and groups, and the angle of view is relatively small. Such a camera, when placed at one end of a room, for instance, will often take in only the other end of the room. Consequently, we must resort to the view camera.

A view camera is adapted to the use of lenses of different focal lengths and the lenses are readily interchangeable. The film back is provided with a groundglass for seeing the exact image before making the exposure, and various adjustments are provided to facilitate altering the image if desirable by such means as raising the lens, tilting or swinging the back, etc.

What size camera is best? There is no best size. That depends largely upon the individual use to be made of it, and consideration must be given to a number of factors. For instance, many commercial photographers prefer an 8 x 10 view camera because of the practical importance of being able to have a full scale observation of the entire picture and all the details. After the film is developed, the full size is again practical for the purposes of retouching, etching, and blocking out when required. And during the printing process, the cost of paper is less than when enlarging is the procedure, this expense item being well worth considering when printing in quantity has to be done. Disadvantages of an 8 x 10 camera are weight and bulk, not only of the camera itself but of the accessories such as film holders, cases, tripods, developing tanks, printers, etc. all along the line. Costs of apparatus and cut-sheet film used are large.

Cameras of the 5 x 7 size are also greatly used by commercial photographers who wish to cut down on the expenses of film required and the amount of accessory apparatus employed. Then all finishing is usually done by projection. Greater portability is also a very deciding point and 5 x 7 is still large enough for easy retouching. Some workers prefer to project from 5 x 7 films to make 8 x 10 prints because they find dodging and shading by projection easier than by making contact prints directly from 8 x 10 negatives. For easy portability, amateurs as a class generally stick to smaller view cameras.

Any serious camera enthusiast making interiors needs a good steady tripod. There are many varieties, both wood and metal, on the market, so that a description need not be given here. But it is well to mention that whatever kind is chosen should have a brace or other gadget that keeps the legs from spreading apart and letting the camera fall and suffer damage because of slippery floors.

LIGHTING

For photographing interiors, my favorite portable lighting equipment consists of two 1000-watt "T-20" projection bulbs, each in a reflector that spreads the light through an angle of about 90 degrees. The two lamps in reflectors, two metal tripods, and several lengths of lamp cord go compactly into a fiber case. Most of my interiors are made with only one lamp, moved about as required, the other lamp being held in reserve in case the first burns out. The 1000-watt projection bulb is excellent for professional use because of its long life (due partly to its sturdy construction of filament and large "mogul" size base) and because by fitting vertically into the reflector, the latter shields it all around except in front, thus giving maximum lighting efficiency. Disadvantages of this lamp for amateurs are its high cost and the fact that it draws ten amperes of current. One must guard against using it on a circuit already loaded with existing lamps or other appliances in the home. Also, special attention must be given not to put two of these bulbs on one circuit unless the fuse is at least 20 amperes, otherwise time and patience will be lost by the bother of locating and replacing burned-out fuses.

Excellent interior illuminants for amateurs as well as professionals are the popular photoflood bulbs that come in sizes numbered 1, 2, and 4, with light ratings equivalent to wattages of 250, 500, and 1000, respectively, and drawing 2.2, 4.4, and 8.7 amperes, respectively. They are reasonable in price and readily obtainable. So are the reflectors to use them in, but here it may be said that for photographing interiors most of the reflectors are none too large for the No. 2 bulbs and prohibitive in size for the No. 4. Nevertheless, one can get along nicely with the No. 2 size by being sure to shield the ex-

traneous light from the lens during exposures.

APPROACH

Now, with sufficient equipment in hand, we are ready to enter a home or office and start to work. What is the first thing to do? Obviously, we must have a purpose for any single photograph or series. The purpose of photography of interiors is invariably to show the most interesting architectural or decorative features of a building so that people may learn what the place is like without actually traveling in person to see it. The composition goal is paramount in order to attract attention at first glance and then make a person's eye linger consciously or unconsciously at ease while the picture details are studied. I believe in a little flattery here and there, but not in stunts that create a wrong impression and serve no useful purpose. If you have your portrait made, you want to look your best and you tidy up to show off your choicest features, do you not? Just so, in photographing a home or other interior!

Well, here we are in the hallway of an early colonial home in Connecticut, depicted in Figure 1. We've been all through the house, absorbed as much as possible of the antique atmosphere of the place and done a little wondering as to what sort of life we ourselves would have led had this been our abode in olden days when candles were in vogue.

Since the front hall stair was one of the first things to catch our fancy on entering the house, we tried to build an interesting photograph around that winding wooden series of steps to the second floor. First thing to do is set up the camera and get a lamp in readiness. Well, what are the possible points of view for a good composition? Here, there seem to be only three. A shot through the outer doorway looking directly at the stair precludes our showing more than a portion of the stair because of the narrowness of the hall, so we reject that. Another possibility is from the living room door into the hall, but that is also rejected because the main item of interest shows less and less as we back away towards the living room. We choose a view through a doorway at the left of the entrance. The vista through the hall and up the stairway is excellent, and by leaving the living room door open we can give an added touch of colonial atmosphere without detracting too much from the main theme. With the 18cm Schneider wide-angle lens in the 8 x 10 camera, we are able to show the entire stairway from top to bottom, and, fortunately, all of the doorway opening into the living room. The dark edge of the wall at the right keeps the eye from running away in that direction off the picture margin.

Are we all set for an exposure now? No, not yet. What about the furniture, rugs, etc.? Are they properly placed for eye appeal? Special care has to be given in this regard, otherwise our inattention to the details can cause as much concern to the onlooker as ants in a luscious apple pie. Before a photograph of an interior is taken, one should consider every single object in the room and determine if each is properly placed, as the camera sees it. For instance, the rug in the foreground had to be moved away from the camera to look right in the photograph, otherwise with only the edge of it showing, it would be annoying so close to the bottom margin. Similarly, the rug in the living room had to be pulled more to the right, to soften the bareness of the floor. The book and pillow on the bench under the stair were not there at all, at first; they were added to give a human interest touch. In the other room the picture was straightened and the quaint straight-back chair was brought into view to look natural in the picture. The latter, however, was entirely out of normal position in the living room itself, as was also the flower table, pulled too far from the window. But it all looks right in the photo. Time and good judgment are required to arrange the objects that are parts of one's composition, but results are very much worth while.

It goes without saying these days that panchromatic films should be used for making interiors because of their good color tone rendition, and one of the portrait varieties is recommended to assist in giving soft pleasing shadow detail. Good detail in either shadows or highlights, however, is more a matter of proper exposure and development than of the type of film used. For this particular picture, it happens that Agfa Isopan film was

used, with the lens stopped down to f/45. To look at this subject, one might not suspect that artificial light was almost the sole illuminant. The daylight entering the living room through two windows, and entering the hall through the open door was not at all

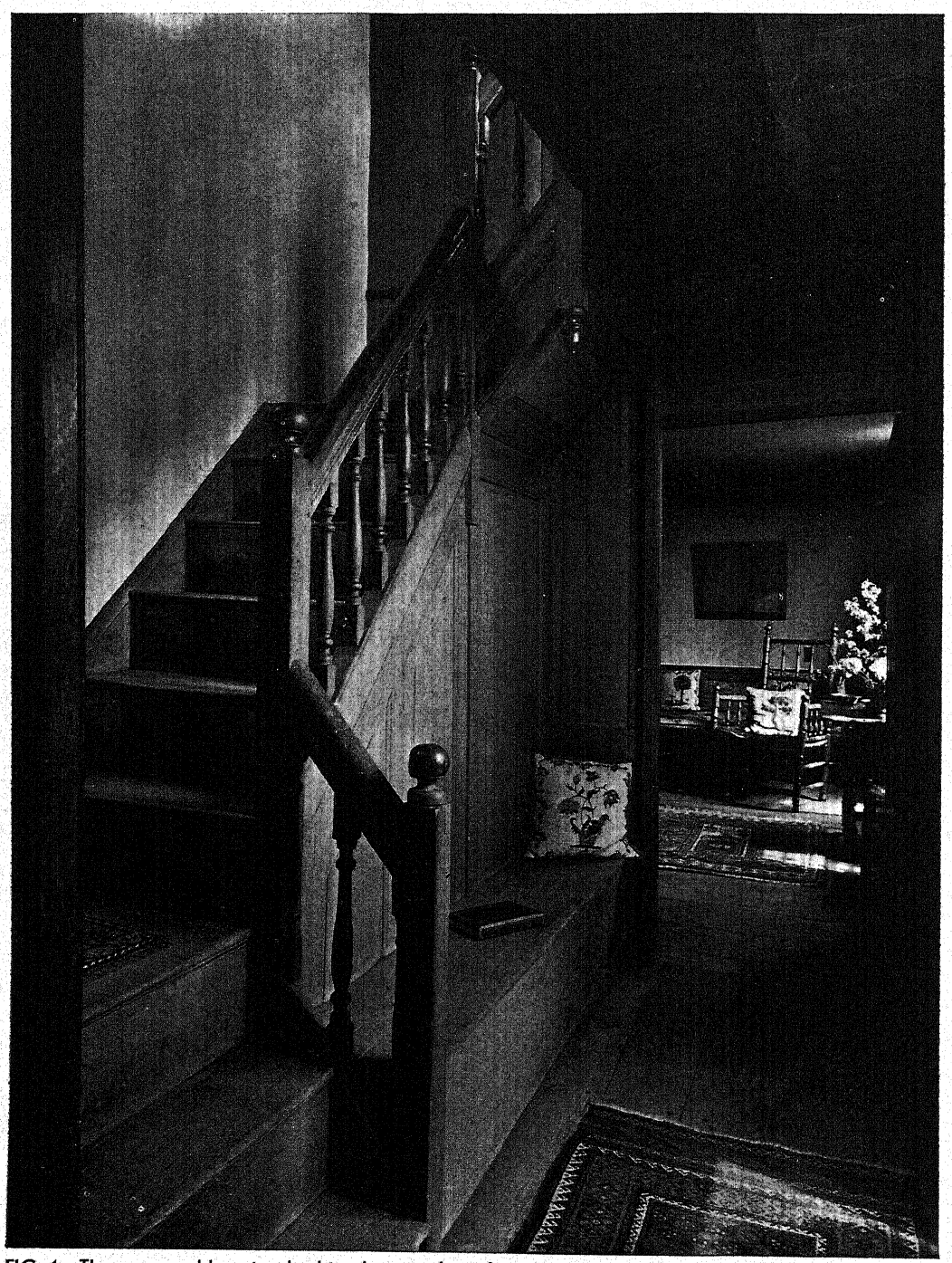


FIG. 1. The many problems involved in photographing this interior are described fully in the text. Although the effect is of daylight illumination, most of the light came from artificial sources. And the angle of view was carefully chosen to give depth to the stairs, to show the far room, and to include framing at the left and right edges

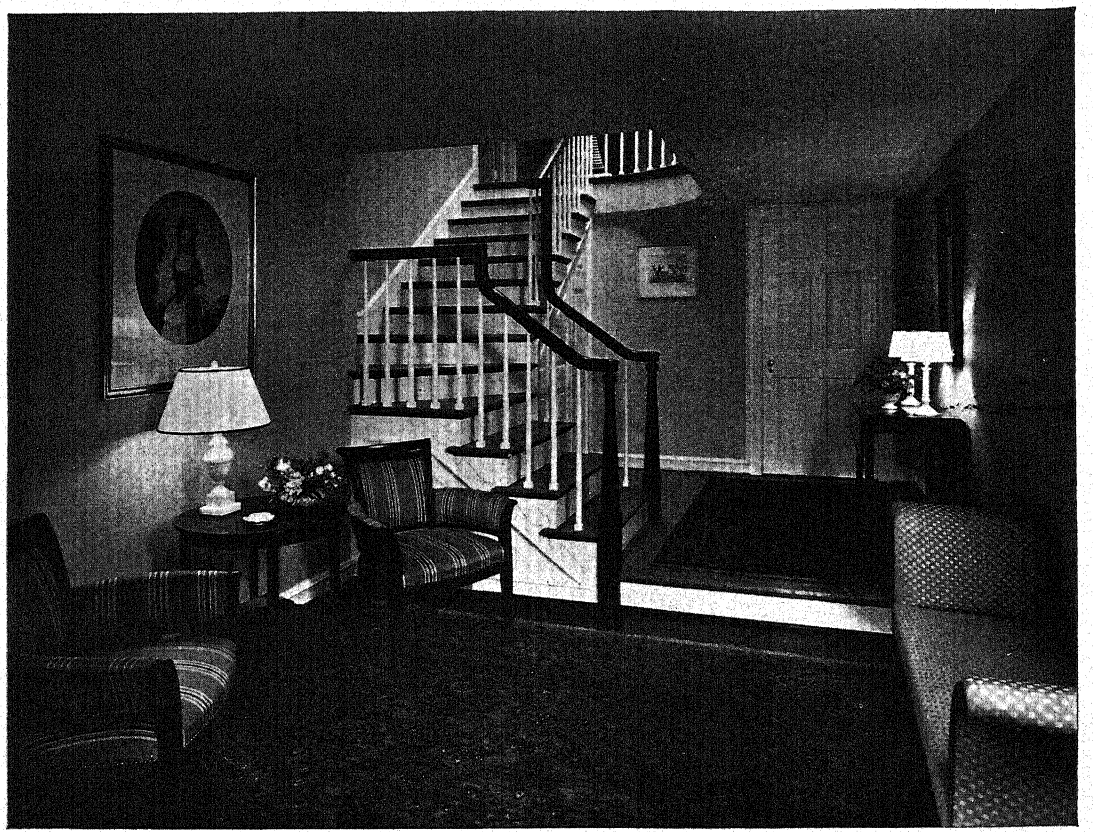


FIG. 2. Where almost no daylight is available, the artificial lights must be made to simulate light from a consistent and natural source. Here the entire hallway is amply lit, though the light seems to come solely from the lamps and the stairwell

suited to give the effect shown. There was an abundance of light on the floor near the windows and door but otherwise the dark woodwork absorbed so much light as to be almost black and an exposure under the existing condition would have made a very poor negative. The solution was to employ two 1000-watt lamps, one of them on a tripod in the living room close to the windows around the corner to the right just beyond the flower table, and the other held in an assistant's hand in the doorway at the right of the camera. The first lamp served to spread light into the living room and the second illuminated the woodwork of the hall in a manner agreeably surprising. It happens that one can see the assistant's shadow in the sunspot on the floor as he stood there in the doorway and moved the lamp up and down and crosswise during the exposure to get rid of sharp tell-tale shadows of the balustrade on the light toned plaster wall at the left, also to distribute light over towards the living room door and a bit on the ceiling.

Did the portable lamps in these two positions give sufficient over-all illumination? What about the upper hall lighting? In the photograph, it appears as if light reached the top of the stairway through a window in the upper hall. Actually, a window did exist there, but insufficient light came from it to be effective. Therefore the next procedure after taking care of the downstairs lighting was to close the shutter of the lens, turn out the lamp in the living room, close the entrance door to the hall to darken the lower hall, and carry the lamp used in the doorway up to the top of the stair. Then the shutter was opened again and the assistant pointed the lamp downwards to light up the top of the stair and make some highlights on the balustrade, as well as on the stair treads.

The exposures for the negative of this picture were half a minute in the living room,

one minute through the doorway, and fifteen seconds downwards from above. Two other negatives were made with half and double these exposures. It is the author's practice to make three negatives of each architectural interior, usually in the ratio 1:2:4. Most of the time the medium exposure is best, but the leeway on either side of the medium is worthy assurance of getting the best results possible.

INTERIORS WITHOUT DAYLIGHT

Now, suppose we have a hall with no daylight to speak of, such as that of Figure 2.

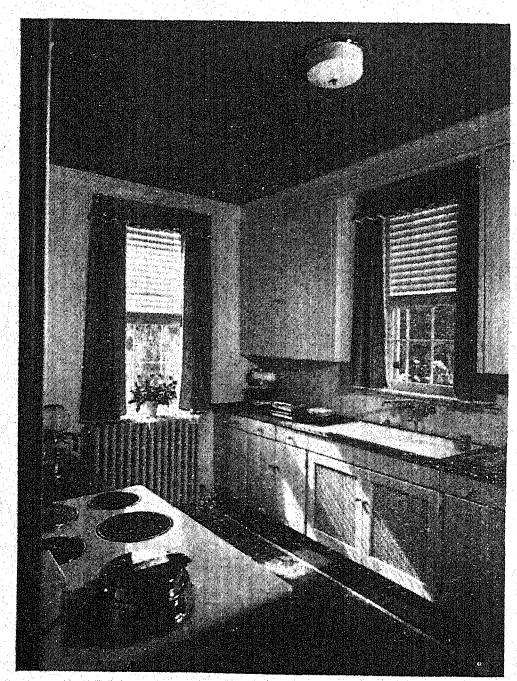


FIG. 3. Planes must be carefully separated when photographing an interior. To give a feeling of roominess to this kitchen, to give space between the sink and stove, for instance, a strip of floor must show. Also notice the patterns of sunlight cast by the blinds

What to do? Use the imagination to create an illusion of natural lighting, in this case from the table lamps seen in the picture and possibly from a chandelier in the upper hall. These existing lights were not sufficient by themselves to give the desired results, hence the use of artificial lighting besides. Close examination will easily reveal, of course, that supplementary lighting was used, but few people not photographers would ever stop to figure it out.

Figure 2 was made with a single 1000-watt bulb placed first at the right of the camera for three-quarters of a minute at f/45 and moved as much as possible to get rid of obvious shadows, then carried to the left of the camera for ten seconds more with constant movement. Next the shutter was closed and the assistant went upstairs to shine the lamp down over the railing for another half minute, with enough movement to soften the shadows formed. Because of the down lighting being brighter on the far wall than the lighting from other sources, we are aided in getting the feeling that there is actual space up through the stair opening to the second floor. After the flood lighting as just described, the table lamps, which had been left on all the time, were allowed to expose another minute to give the realistic looking highlights around them.

The entrance hall photograph just discussed was made with the Schneider 18cm wide-angle lens in the 8 x 10 camera. Note that the taking position was not directly in center for this photo, but considerably to the right in order to get a good perspective of the staircase and to separate the balustrades. This separation helps again to give that third dimension feeling in the picture.

SEPARATING PLANES AND TONES

Now let's take a kitchen. Everybody likes to see a nice tidy room for preparation of food in the home, and here is such a place in Figure 3. This photograph is an example of good composition because the various areas of light and dark tones are well balanced, thus giving a harmonious feeling to the picture as a whole. The stream of sunshine through the window adds zest and life. One might say "Well, with such a neat modern kitchen as that, anyone could photograph it with no trouble at all." The answer to that one is that the local commercial photographer photographed this kitchen and the rest of the entire house twice for a magazine but I was afterwards sent 300 miles from New York to do the job a third time in order to suit the editor. This is not mentioned as a reproach of the local photographer but only to emphasize that many a photo with eye appeal is only a result of knowing how to plan carefully and build up one's composi-

tions. Good photographs are seldom due to chance and a man earning his living by making them cannot rely on luck.

Let's get back to our kitchen picture. A lot of snooping around was done from various points before the camera was put in its final position. Often a few inches one way or the other makes a considerable difference in the composition. Notice, for instance, the dark edge of the door frame along the left edge of this photo. It helps the observer to feel he is standing where the camera was and that there is space around the corner to the left and in the room itself. Suppose the camera had been lowered six inches. The top of the electric range would have moved up on the groundglass to meet the bottom of the cabinets across the room, thus hiding most of the floor and making the room appear narrower. It wasn't by accident that a strip of wall space was allowed to show at the left of the far window or that the coffee urn was made to separate from the window curtain. Many little details go to make up the whole picture as a unit. Notice how the walls and ceiling stand out as separate planes. This effect was produced by placing the lamp off to the right, away from the camera, to avoid a flat lighting. Without artificial light in photographing this room, the windows would be blocked up on the negative long before the rest of the areas were properly exposed. Take plenty of time when making your interiors. My average is nearly an hour per picture and before I finish, every single object in the room has been taken into consideration.

EXPOSURE

I generally carry an exposure meter on jobs but have found that experience is usually as good a guide as the meter. Here's how I figure it out. When you visualize an average bedroom, for instance, don't you have in your mind's eye a room roughly fifteen by fifteen feet or thereabouts, with the general tone average neither very dark nor very light but somewhere in between? Well, make that your standard to work from and keep it always in mind when making interiors. Suppose you want to make a photograph at night to show a general view of such a room. If you've had no experience to go by, you'd be smart to use a meter to determine the exposure, using, say, a No. 2 photoflood. For this shot, you'd be smart again to make two more negatives, one of twice the meter reading and the other half the meter reading. Then you'd have three negatives to choose from, exposed in the ratio 1:2:4. One of those negatives will always be appreciably better than either of the other two.

Now suppose that tomorrow night you want to photograph Mrs. Tidy's bedroom which happens to be about the same size as your own, and about the same average tone. Knowing the exposure that gave you an excellent negative, you won't need the meter next time; give the same exposure under the similar conditions and all will be O.K. But if her room is considerably darker than yours, then judge first how much more exposure is needed and check it with the meter. Make one negative with the estimated timing, another half as much, and a third twice as much. The important thing is that even with your meter readings, one of three different negatives will be distinctly the best. Keep a record of all exposures and refer to them from time to time.

Suppose again that Mrs. Tidy's room is average in tone but twice as long and twice as wide as yours. Then you'll have to give approximately four times the exposure given to your room because there is four times as much space to be filled with light. The scientific reason is that light intensity on an object varies inversely as the square of the distance of that object from the source of light. Another way of looking at it is to consider the light on the far wall of the room. If the far wall of the room you are photographing is twice as far from the lamp as was the case when you photographed your own room, then you'll need to give four times the exposure to make a comparable negative.

To the uninitiated, such a system as outlined above may sound too involved, but the basic principle is quite simple. For instance, take the bedrooms shown in Figures 4 and 5. The amount of daylight entering them is negligible compared with our artificial light, so we proceed to judge the necessary exposure according to our system of using artificial light. The bedroom with many ruffles may be a bit smaller than the "mind's-eye" room and, accordingly, only 40 seconds is

considered the best exposure compared with the normal of 60 seconds at f/45 with a 1000-watt bulb. The bedroom with bay window may be nearly twice the size of the "mind's-eye" room, and if it were of medium tone, two minutes would be given. But here everything is very much darker all over, so that the exposure must be doubled again to take care of the great absorption of light by the dark areas, and we judge four minutes as the best exposure. In this case we would give 2 minutes, 4 minutes, and 8 minutes respectively, in making three negatives. Again we have a practical leeway for insurance of successful results.

What to do when the daylight is an appreciable factor in lighting a room? Then, of course, we have to take it into consideration. Figure 6 will serve admirably as an example. It is easy to see in this photo that a great amount of light enters the room through the large window, but if we use that alone, the shadows will be very much too dark. Now let's judge the exposure with artificial light according to our system. Here we have a normal "mind's-eye" room for size, but the general tone is on the dark side of normal. Therefore, without any daylight, we'd give, say, a third more time than normal, making 90 seconds. But we judge that about the same amount of light comes through the window as from our artificial source. This is easy to check by reading the exposure meter both with our light off and with it on. If our surmise is correct, the exposure would be judged one half of 90 seconds, or 45 seconds. Consequently, we'd give 23, 45, and 90 seconds, respectively, to our three negatives.

Of course, if a person is constantly photographing similar rooms every day, he can narrow the exposure ratio to 1½:2:2½ or make only two negatives instead of three, or

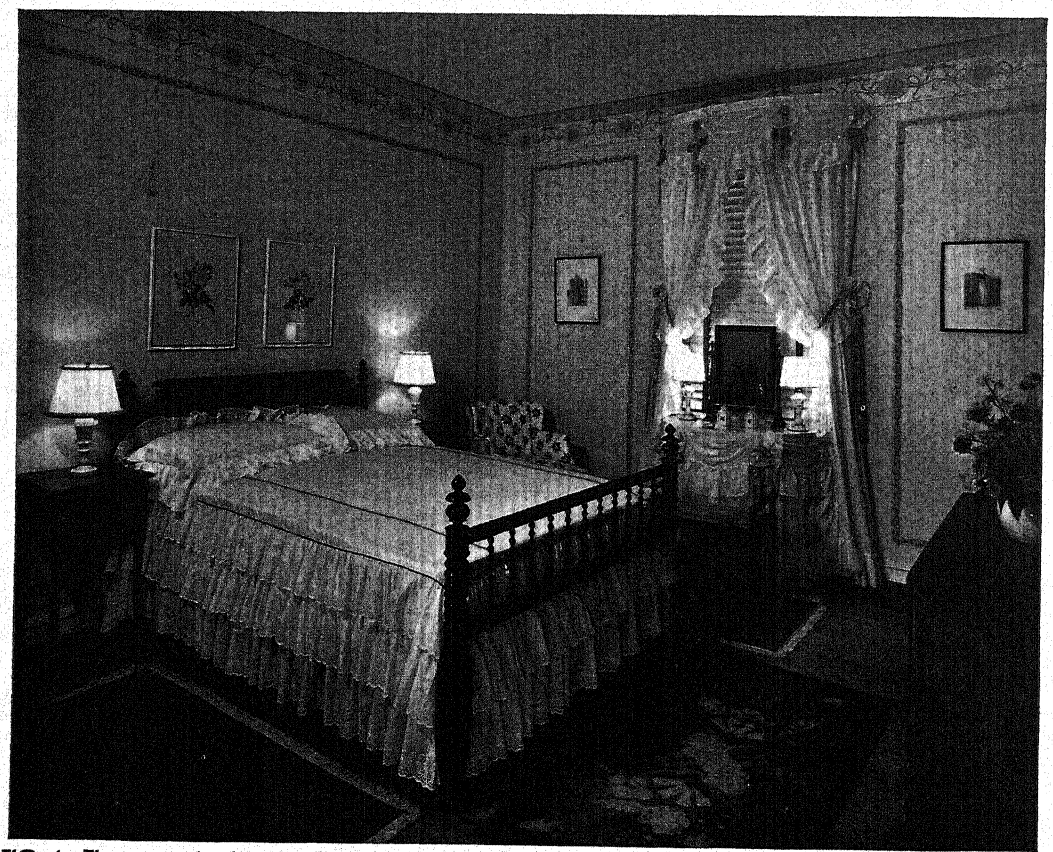


FIG. 4. The size and color of walls—as well as the amount of natural illumination—will determine exposure for interiors. This room has no natural light, but is perhaps smaller than the average interior to be photographed, so you increase exposure for the first factor, but reduce it for the second. With a 1000-watt bulb, the picture was taken at 40 seconds, f/45



FIG. 5. If windows are to show, the light shining through them must be balanced by artificial light—or the window image will "burn out." Very dark walls give added exposure problems. Taken at English Valley, Cranford, N. J.

if he prides himself on ability, one negative will suffice nine times out of ten. But on the tenth time the cost of going back to do the job over again may be many times the saving he tried to make, and it just isn't worth the candle to be so pennywise. Some people may consider this system a lot of rigmarole of little avail when the meter is always at hand, but there is a very comfortable feeling of confidence and a consequent gain in efficiency by using this method of comparing each room to be photographed with a standard set-up kept in mind.

THE CUT-IN LIGHT

Let's go back now and clear up a few incidentals that were not spoken of before in order not to confuse. To get a natural looking effect in a photograph, the major lighting of a room should never be close to the camera, but from a source directed crosswise into the picture from the right or left of the camera. This makes the walls stand out as separate planes instead of appearing almost as one flat plane, and gives a feeling of relief in space to the objects in the room. With light from one side only, however, the shadows are too black, a condition which is remedied by a cut-in lighting on the shadow side to the extent of about one quarter of the major lighting. By moving the lamp constantly during the exposure, harsh shadows are avoided and a pleasing effect produced. As an example, consider Figure 4, where the major lighting was given with the lamp about half way between the camera and the left wall. Care was taken not to let light shine into the lens, and the lamp was moved from side to side and up and down and the light was spread as evenly as possible over the picture area. The cut-in for this photo was given from a point slightly to the right and a bit above the camera because there was no space in which to work further to the right.



FIG. 6. Each interior has its own particular problems and, for this one, it was a question of balancing bright sunlight and artificial light. Besides the main lighting from the left, a cut-in light was used at the right, beyond the bureau

Since the cut-in is only for the purpose of softening the shadows and giving detail in them, it can be flat-on without any disadvantage. For Figure 6, the cut-in had to be around the corner on the right. Notice how important it was to separate the right twin bed from the edge of the chest.

CAMERA POSITION

Very often in photographing interiors, we are able to make a composition more effective by selecting a point of view that is considerably higher or lower than the eye position when one is standing. Figure 7 shows a shot with the camera only a few inches off the floor. Such a point of view worked extremely well in this case to show the utility of the folding door. One reason for this is that the V-shape formed by the angle of the beam over the door with the beam above the sofa in the next room tends to lead the eye from this side of the door through the opening into the other room. Lighting was very important here and the lamps, one in each room, were placed high so that the beams mentioned would stand out dark against the lighter surroundings. By making the far room lighter in tone than the near one, the feeling of distance was further emphasized. After the main exposure was made, half a minute at f/45, both lamps were put out and the near one moved close to the camera to be pointed flat-on toward the subject, thus giving detail in the shadows, particularly in the folds of the door fabric and under the chair at the left. The exposure for the cut-in was merely a flash of a couple of seconds, the lamp being kept in motion to prevent a definite shadow to conflict with the main lighting. This picture is a good example of use of a rising front on the view camera to get rid of foreground.

An excellent subject to illustrate photographing from a high point of view is a detail of the House of Burgesses in the Capitol of Williamsburg, Virginia, shown in Figure 8. The perspective here was made unusually interesting by showing parts of the table and chandelier in the foreground. Foreground treatment is quite an art in itself and deserves a great deal of study and practice. An important point to remember is not to make the foregound so pronounced that its interest takes too much attention from the main

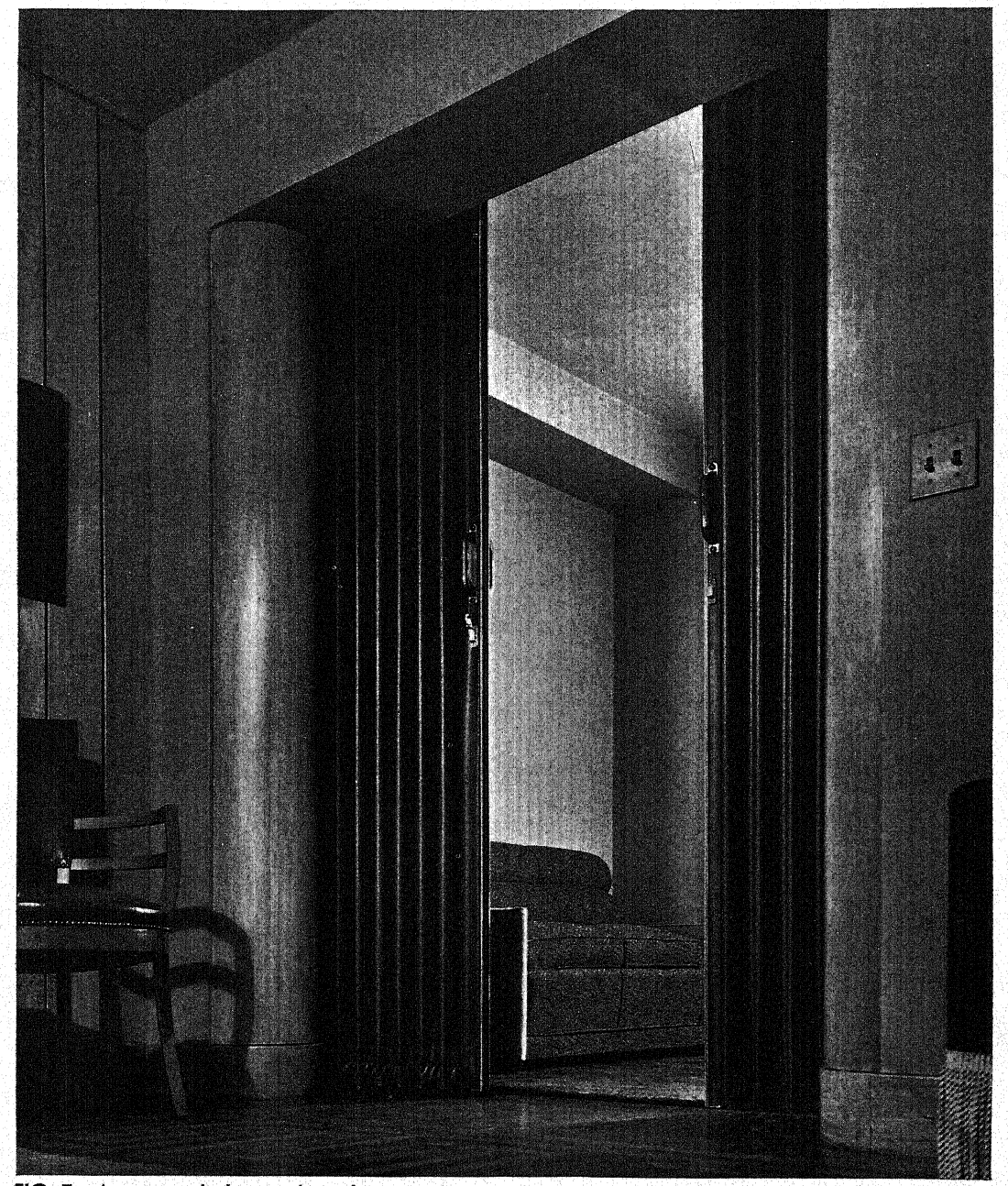


FIG. 7. An extremely low angle and a rising front on the camera to prevent distortion are the keys to this dramatic interior view. The purpose of the photograph was to show the folding doors. An interpretation in line and texture, all brought about by angle of view and lighting

theme. Here, the far wall stands out prominently because of the contrast between the dark paneling, paintings, and coat of arms, and the white wall surface. Remember that the eye is always attracted most strongly to the points of greatest contrast in a picture. Use this rule to light your subjects in such a way as to make people see, unconsciously, what you want them to see. For instance, look again at the folding door picture and see how emphasis was placed on the doors themselves by the contrast of tone of the doors and the wall surface beyond.

LARGE INTERIOR

If you wish to photograph a large commercial building interior and have to resort to portable lighting entirely, your previous experiences with small interiors will stand you in good stead because the principle of lighting a large space is the same as for a small one. The difference is that your lights may be too weak to cover the picture area effectively. Figure 9, photo of the shoe department in a Fifth Avenue store, looks as if it were made with one lamp placed beyond the column at the right edge of the photo. That was the major light source, but it didn't light up the shadows nor did it light up the curved wall evenly. A second lamp was used, while the first one was on, to spread the light evenly and take away the harshness of the shadows. By moving the second lamp continuously it did not destroy the appearance of single lighting. The trick is to cut in just enough, never more than 25 per cent of the main lighting. To make this photo effective, lighting was no less difficult than the arrangement of furniture after finding an appropriate point of view to make a good composition. Every piece of furniture and other article was moved into position as seen. The foreground chairs that look so evenly spaced were anything but even in the room itself, and the row of seats that appear in the very center of the curved bay between the two doors were about six feet off center, actually. Notice the natural looking distribution of shoes around the far column. This was just one of the many small items taken into consideration to make a well balanced composition.

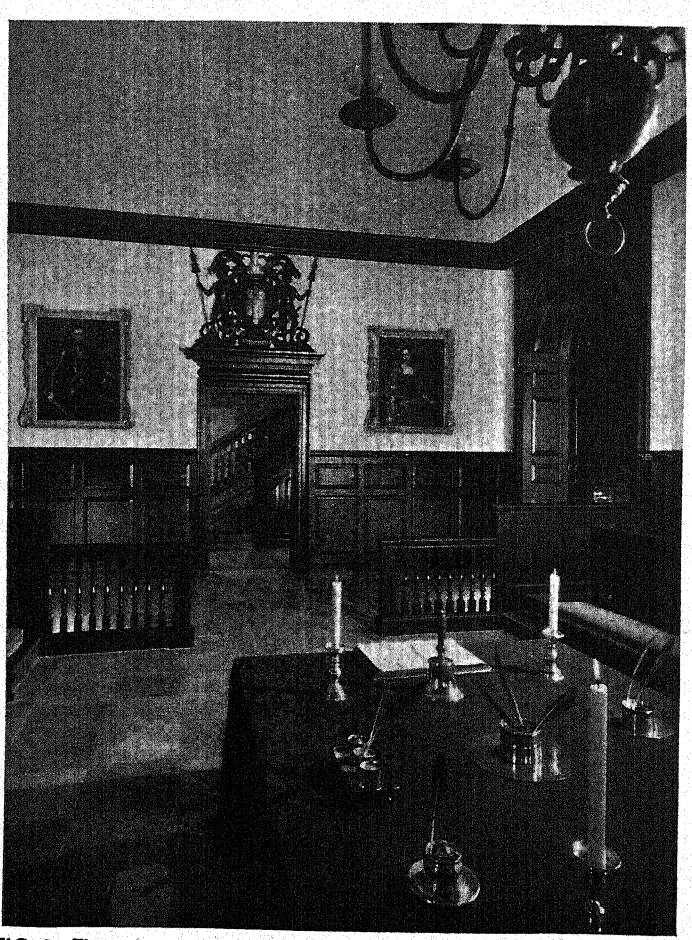


FIG. 8. This is a view of the House of Burgesses in the Capitol at Williamsburg, Virginia. The foreground details of the table and chandelier add local color to the scene and also play an important part in giving the feeling of depth. And the characteristic contrast of the wall decoration has been preserved

CONCLUSION

The reader has probably gathered by now that photographing an interior is not at all a routine matter. It is a fact that each photograph is and must always be

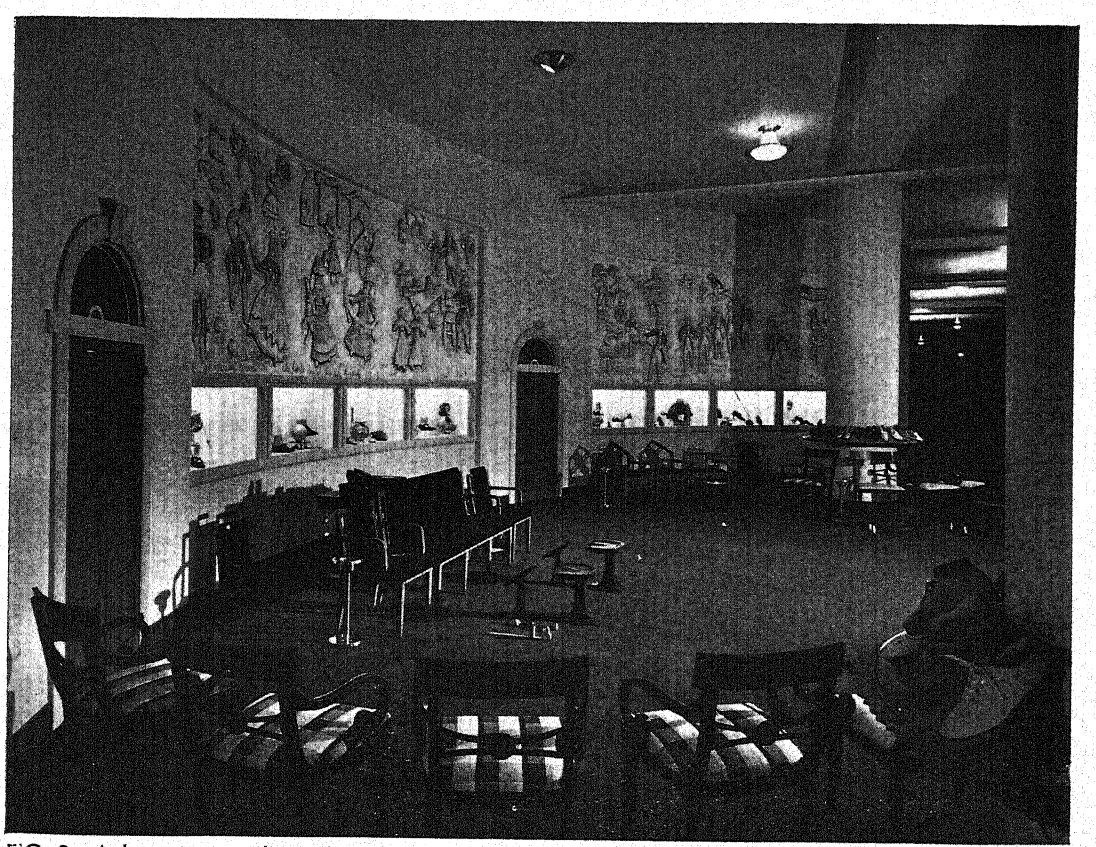


FIG. 9. A large interior demands extensive illumination and extraordinary depth of field. Notice here that the nearby shoes and the far-off wall figures are in focus. For a detailed description of the lighting scheme, see the text

a separate problem by itself. This is so because the arrangement of light and dark areas in front of the camera, consisting of furniture, wall decoration, etc., is never twice alike. Remember that a photograph is possible because light strikes the subject first and is then reflected toward the camera, through the lens, and onto the film. Because we can control the source and intensity of light reaching the various light and dark areas in front of the camera, we are able to paint with light, so to speak, and thus build at will the composition appearing on the groundglass.

With these things in mind, the definition of photography as "painting with light" seems particularly suitable. Good lighting technic—combined with a thorough knowledge of photographic processes and an appreciation of basic composition—is a prerequisite for the amateur or professional photographer of interiors.

INVESTIGATING DOCUMENTS WITH PHOTOGRAPHY

John Fawcett Tyrrell

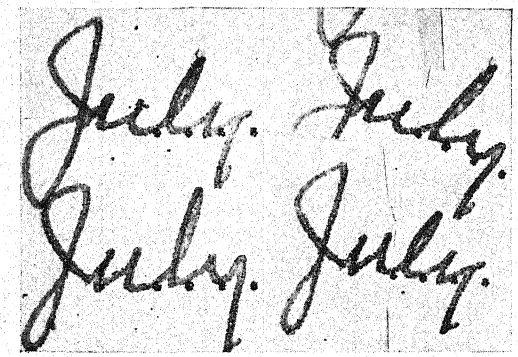
Document Examiner, Milwaukee

Document photography is refined copying—with the very special purpose, in this case, of substantiating investigation evidence. The author has used his photography to give important information in many hundreds of legal cases—among them the Leopold Loeb case, the Magnussen bomb matter, the Lindbergh kidnapping, the Allis Chalmers C.I.O. Election Fraud hearing. He covers photo-examination through high magnification, decipherment of charred documents, and tells of several interesting cases.

All photos by John Fawcett Tyrrell.

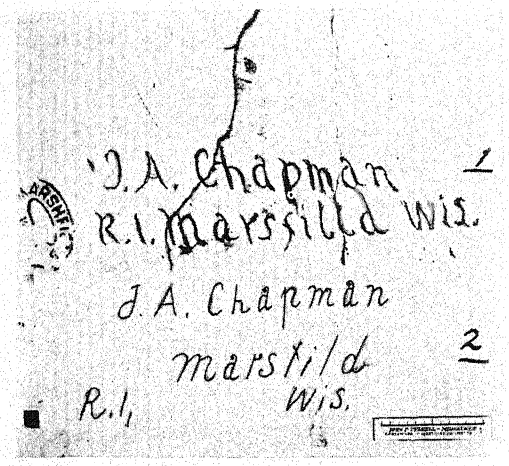
See Also Copying, Criminology and Police Photography

PHOTOGRAPHY IS INDISPENSABLE to the modern document examiner for several reasons. The public may not know it, but every document submitted to the experienced examiner is photographed, regardless of its importance. Accurate enlargements



COMPARISON EXHIBIT. An outlawed note was claimed to have been endorsed with interest payments before the expiration of the limitation period. It was denied by the maker that any payment had ever been made. The ink of both entries, however, was of a peculiar blue ink—visually and chemically identical. To prove that the same pen was used for both entries, an enlarged photograph of the endorsements (left) was cut apart and interchangeably assembled. The definite matching of severed ends of the lines, both in width and quality, decided the dispute

are more than the equivalent of low power microscopic inspection, and may become extremely valuable in the absence of the original. There are a number of Supreme Court decisions to the effect that where for any reason an original document is not available, an authentic photographic copy of it may be received in lieu of the original.



HANDWRITING SIMILARITY. A printed address on the wrapper of a package containing a bomb (above) was sent through the mail. The explosion burst the paper (note the tears), but did not efface the address. The sender, assuming that nothing remained of the bomb after the explosion, boastfully showed his adeptness at printing (below). A number of other circumstances, in addition to pen printing similarity, brought about his arrest and sentence to life imprisonment. Used in *State of Wisconsin versus Magnussen*

SCOPE OF DOCUMENT TECHNIC

Documentary prints cut apart and arranged on cardboard as comparison exhibits, numbered to show the exhibits from whence taken, the necessary legend inscribed, and the assembled whole photographed to supply exhibit copies in quantity (in actual size or in enlargement to be indicated by a scale included in the original) may in many instances be the most convincing demonstration in support of certain phases of testimony. To tell a jury that the concluding line of a contract was written after signing obviously calls for demonstration of proof. It may in some cases be supplied by an accurate enlargement of the item. That the insertion of a word or words in a typewritten document was not done on the machine on which the rest of the sheet was typed may be proven if the fact is convincingly illustrated by an enlargement of the subject. Ink patchings, mendings, alterations, writing over folds in the paper may be so clearly and convincingly demonstrated in enlarged form by photography as to settle all dispute of the points in controversy. Many a case has not gone beyond the attorney's office because of the evidence of the expert's photographs.

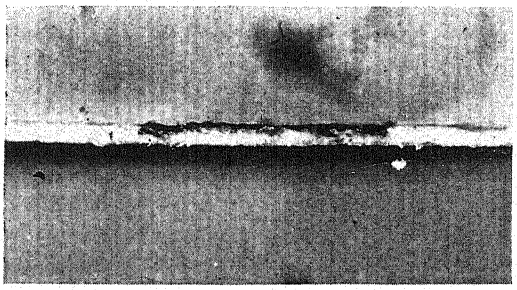
The documentary matters that find their way into the laboratory of the examiner are many and varied. Some are particularly outstanding in uniqueness, but each case appears to have its own peculiarity, even the more commonplace matters.

The problems may involve various kinds and grades of papers, their watermarks, size, fiber, weight, pulp or rag content, chemical treatment. A variety of pencils, inks, pens, fasteners, seals, stamps, stencils, handwritings, and typewriting present their problems. In short, anything that enters into the make-up of a document is important —the behavior of some inks upon certain papers, sequence of lines, superimpositions, pencil or ink upon typing, or rubber stamp impressions.

Obscure or obliterated writings are often decipherable by means of photography. In instances, a pencil note has been changed from a simple message to a friend to a promissory note or other obligation. The friend lost the paper; it got into the hands of

an unscrupulous person who erased the message and inserted instead a typewritten obligation. Photography by the infrared process rendered the original message visible, disclosing the fraud.

Chemically erased ink entries may be solved by photography, using the ultraviolet process. A check for a considerable sum had passed in a shady political deal, made payable to bearer. The bank teller insisted on an endorsement. In a subsequent investigation, the check became an important exhibit. When shown, its endorsement was merely a rubber stamp impression, "Return Receipt Requested," and an unidentified signature in pencil. In an ultraviolet photograph the signature demanded by the teller appeared under the stamp impression. When the politician was confronted by the expert's photograph he remembered quite a bit about the affair, though he previously had denied any knowledge of it.

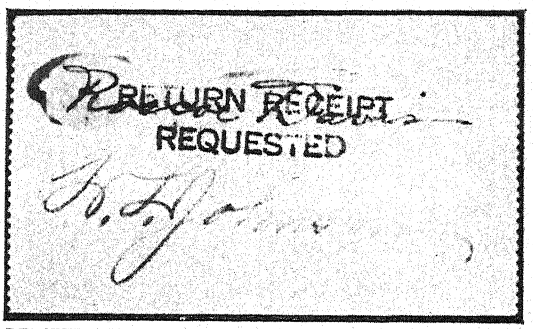


INK PENETRATION. A cross section of a sheet of paper 3/1000 inch thick was photographed showing the penetration of ink in a ruled red ink line. This photo, used in a case against an insurance company, proved that an entry had been made

Anything that can be seen can be photographed—to which in document photography must be added, "many things also that cannot be seen."

HIGH MAGNIFICATION WORK

The study, examination and analysis of documents frequently requires the use of the low power microscope. By photography the image viewed under magnification may be reproduced in permanent form in all its modulations of shade, tone, and exactness, except color, which requires a special process. Such photographic prints can be referred to as the occasion requires and, when placed in juxtaposition, comparison with similar copies

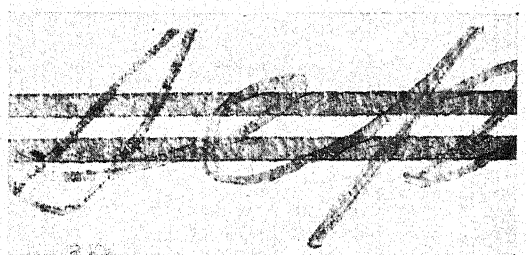


PENETRATING AN ERASURE. Ultraviolet photography was used to prove that this check had been signed, that the signature had been erased and overstamped with "Return Receipt Requested." The photo was used in detection of a shady political deal involving graft

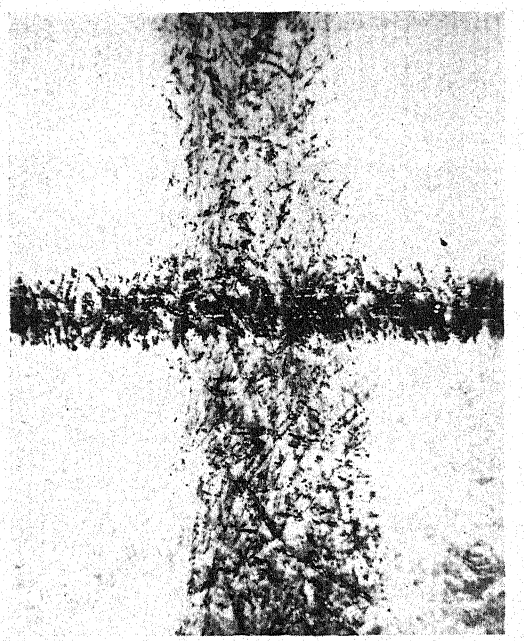
of questioned or standard exhibits becomes convincing evidence of identity or of divergence, as the case may be, and reveals qualities not readily apparent in the microscopic magnification.

Occasionally a bad pen may produce a distinctive mark, a defective pen nib abrasing the paper surface, causing a roughened furrow and excessive ink penetration. An enlargement is an excellent means of demonstrating that fact. It may be highly important to determine the sequence of a fold in the paper of a document as related to the ink line crossing it. If the fold has disturbed the finish of the paper or affected its fibers, the loosened condition of the surface due to the folding will cause an incursion of ink into the fold. And vice versa—if the paper has been folded later than the writing, that fact will be apparent.

A dried ink does not run. The sequence of two crossing ink lines is frequently a matter of dispute. Which of the two was first upon the paper? The degree of certainty in such a problem will necessarily de-



OVERWRITING. This photograph demonstrated to the satisfaction of a jury that the "September" was inserted after the account had been closed



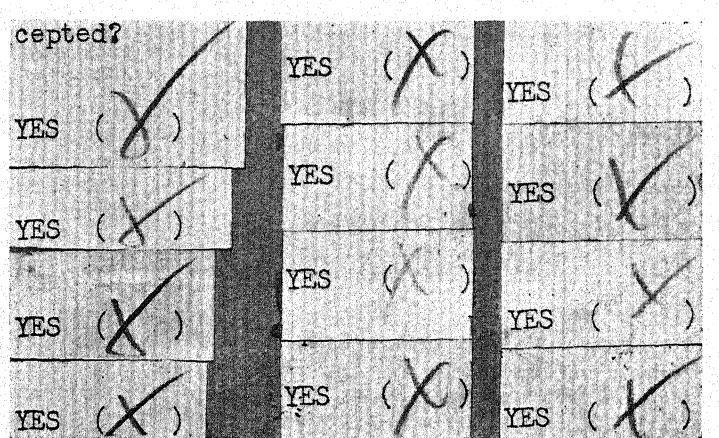
CROSSING PENCIL STROKES. When two pencil strokes cross each other, the top one shows continuous striations and the bottom striations are broken

pend upon the quality of the ink, the character of the paper, and, to an extent, the kind of pen used. Where the marginal deposit of one ink has been disturbed, softened, or partially obliterated by the contact of the other, it is presumed to indicate the underlying ink as the one affected. In some cases an ink will, when passing over a dried ink line, spread out upon it quite definitely, depending somewhat upon the affinity of one ink for the other, and in fluidity and absorption qualities. But in any event, an enlarged photograph should be made, in several lightings and with a filter, if indicated. A properly prepared enlargement should be of assistance in the solution of the problem. It is, of course, necessary that such enlargement be clearly defined and show the paper fibers as well as the delicate ink margins of both lines. Such attempts should show impartially all of the facts pro and con and, in the interest of justice, be for no other purpose. With high magnifications, an attached moderately enlarged copy of the subject is an assistance to intelligent interpretation of the enlargement.

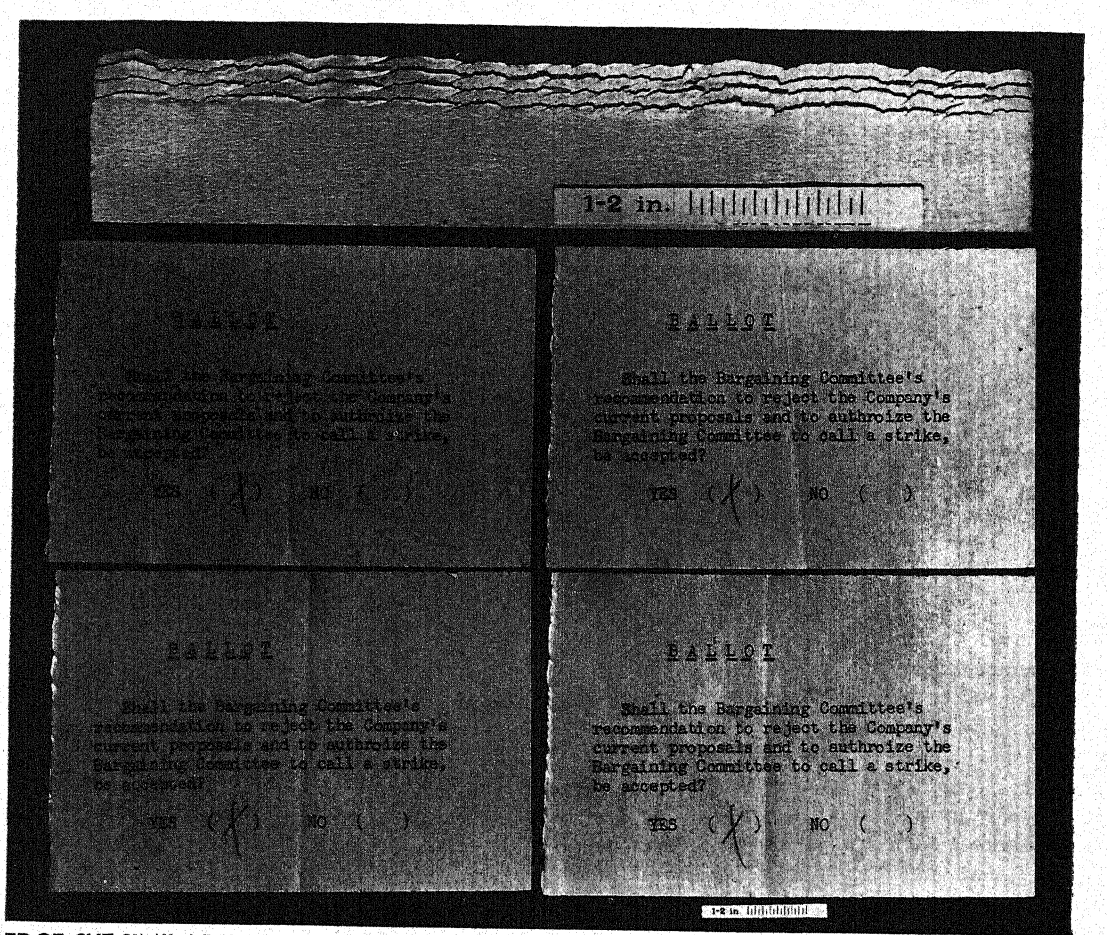
Photographic lenses necessary for high magnifications are obtainable of 15mm focal length, which, if stopped down, will produce a beautiful depth and definition, always highly desirable. As an instance there is the delicate matter of identification of two pieces of paper as originally in one sheet, by the coincidence of their marginal fibers in a magnification of 70 or more diameters.

The sequence of two crossing pencil strokes may be determined by the interruption of striations, or fine silvery lines, when viewed in oblique cross light. If such occurs at the juncture of the two strokes, it will have been caused by the second line in its passage across the first, breaking the continuity. Confirmation may be had by directing the light similarly across the second stroke, whereon its striations will be shown to form continuous lines.

Filters. In some instances, with the use of an appropriate filter, the fact that a differing ink was used in the alteration of a document may be convincingly shown. Various color filters may be used in copying certain tints or colors which are otherwise practically non-photographicable or not distinguishable. In general, to darken a color, use a filter which absorbs it (i.e. darken blue lines with a red filter). And for more on this see the articles on *Copying* and *Filters*.



BALLOT FRAUD. Each of these three rows of marks was made by one voter—showing fraud in the strike ballot



EDGE CUT SIMILARITY. *In the ballot fraud, further proof of multiple voting was given by similar edge cuts. These four ballots not only were marked by the same man but were all torn from the pile by the same knife edge at the same time*

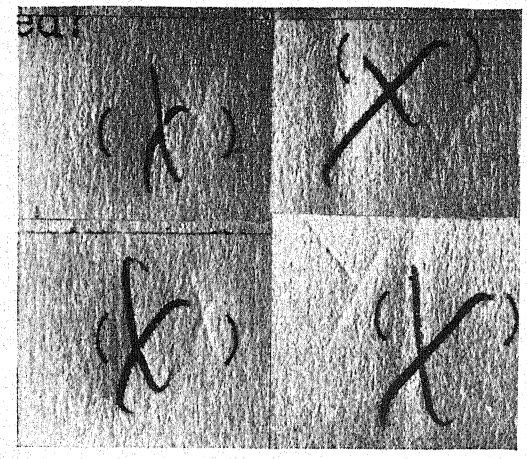
STRIKE BALLOT FRAUD

An outstanding instance wherein photography played a major part in proving fraud was the case of the Allis Chalmers C.I.O. union No. 248 strike vote, heard before the Wisconsin Labor Relations Board at Milwaukee in March, 1941. At the hearing photographs were introduced, prepared by the document examiners,* and they were an effective means of demonstrating the fact that the strike vote was fraudulent.

The C.I.O. union had, in the January previous, held an election to decide to go out on strike. However, since the number of votes cast did not meet the state requirement, the attempt failed, whereupon the officials of the union immediately ordered a second election which resulted in an overwhelming majority in favor of the strike. Because of the fact that the company had counted the employees filing into the C.I.O. headquarters to cast their vote and found them to be about 2,500 short of the total claimed, an inspection of the ballots was ordered. The result of such examination clearly demonstrated the fact that approximately 40% of the ballots cast were fraudulent. The proof of fraud was demonstrated by photographs of the ballots.

The story of the election is, in part: At the close of the election the contents of the ballot boxes were dumped upon a large table about which five tellers were engaged in separating the "no" from the "yes" ballots, and counting them into packets of one hundred each, secured by rubber bands.

*The author and James Clark Sellers, Document Examiner of Los Angeles, California.



GHOST CROSSES. In the ballot fraud, some ballots were found with ghost impressions, made from superimposed ballot marking

When submitted to the experts for examination, the ballots, it is important to note, were still in the same order as when received from the tellers.

The ballots had been prepared in the office of the union and were printed from a typed stencil—eight ballot forms to the sheet of paper. These sheets were cut into single ballots on a cutting board, the knife of which did not in all cases make a clean-cut edge, and, as there were several sheets cut at the one time, each ballot showed the similarly cut edges of its group, identifying the relationship in position and sequence (see illustration above).

As stated, the ballots came into the hands of the experts as counted by the election tellers and were kept in that order throughout the expert examination. This examination disclosed a great many identical forms of cross marks in sequence—in one instance continuing through a straight thirty eight ballots, unquestionably the work of one voter. Other groups in identity ranged from two ballots upward, but many of the pairs and triplets or more were merely separations from a larger group.

Many of the ballots showed indentations of cross marks from other ballots, caused by the pressure of the pencil in marking a superimposed blank, evidence that the voter had a quantity of blanks before him when voting. Of course, there were many ballots honestly marked for the strike and upwards of 750 against. These for the greater number were carefully made and were in contrast to the spuriously marked, when the stuffers went into mass production.

Upon these ballots being arranged in columns the evidence of fraud was glaring and, to demonstrate this, photographs were prepared. These so clearly showed the method and character of the fraud that the Trial Board unanimously declared the vote fraudulent and charged the responsibility to local union officials. Upon the conclusion of the hearing, the photographs and testimony were taken to Washington by plane and exhibited to the National Labor Relations Board.

DECIPHERMENT OF CHARRED DOCUMENTS

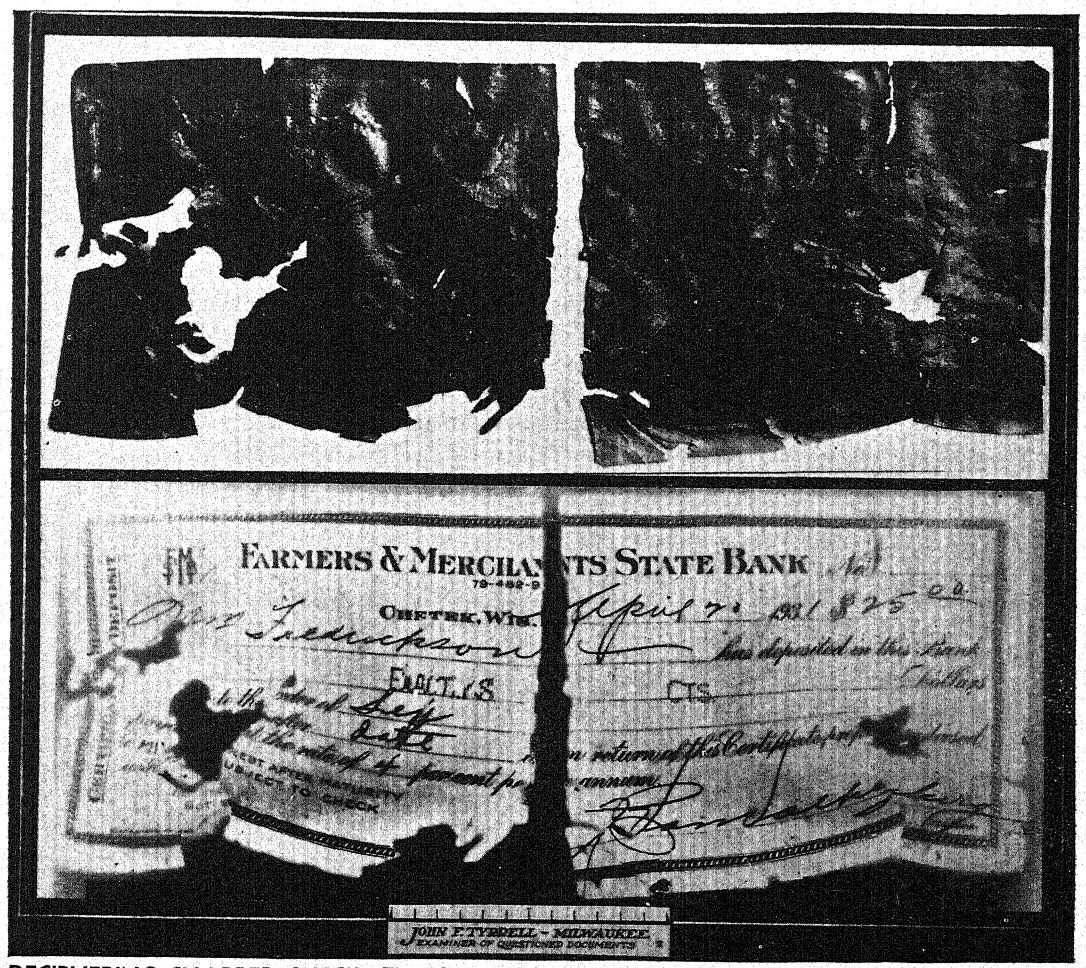
William Frederickson of Chetek, Wisconsin, a bachelor recluse, lost his life in the fire that destroyed his home. The neighbors inspecting the smoking ruins discovered an iron strong box, the contents of which burst into flames when the door was pried open. The door was quickly closed, but the mischief had been done; the contents were thoroughly charred to a dense black. It was in this condition that the contents, still in the iron safe, were submitted for inspection. The attorney considered it a hopeless task and entertained no expectation that any treatment would yield worthwhile results. Yet the decipherment of the contents of these charred, blackened remains was astonishingly simple.

The fire had of course taken all life out of the contents of the little safe. The papers had become stiffened and exceedingly brittle. Some evidently had been tied around with a string, producing a decided "waist line." The least bending produced a breaking away of the part and, of course, where the paper had been folded it was impossible to flatten it through the fold. Making the most of a bad situation, the charred sheets were carefully separated and the sheer pieces arranged on a sheet of white paper and taken into the darkroom where the fragments were placed between ordinary commercial photographic plates. The plates were next placed in a light-proof box, under a heavy weight to insure contact. Fifteen days later the plates were developed as negatives, from

which prints were made. Photography, sans lens, sans camera! The illustration below shows decipherment by this method.

A serious objection to this method of decipherment is the time consumed in its operation. A remedy was sought in direct photography. The charred remains of one half of a typewritten letter was photographed with a Vollmer and Schwing document copying camera, using an ordinary Eastman commercial 8 x 10 film, Cook process lens at f/16, Wratten Experimental Filter No. 45 (blue), a violation of the conventions. Illumination was one 500-watt clear Mazda at 4 feet; exposure 60 seconds. The result was an easily read copy of the contents. The distinctness of the copy was improved by two successive diapositives, the print from the latter being highly satisfactory. This method has the advantage of a greatly shortened time period.

Among the contents of the same safe were a number of bonds, the description of which, on the outer side, had been printed in ink of such character that it had assumed a decided gloss when subjected to the heat of the fire. To photograph these, the charred bond was secured to the camera object board tilted slightly forward toward the lens; the angle of incidence yielded a brilliant, even reflection of the subject on the groundglass. A 500-watt Mazda below the lens supplied the necessary illumination. The lens, a Cook process, was stopped down to f/32 for 9 seconds on Eastman orthochromatic film.



DECIPHERING CHARRED CHECK. This photo was made without a camera. The check was put between two photographic plates and, after fifteen days in contact, the above image resulted

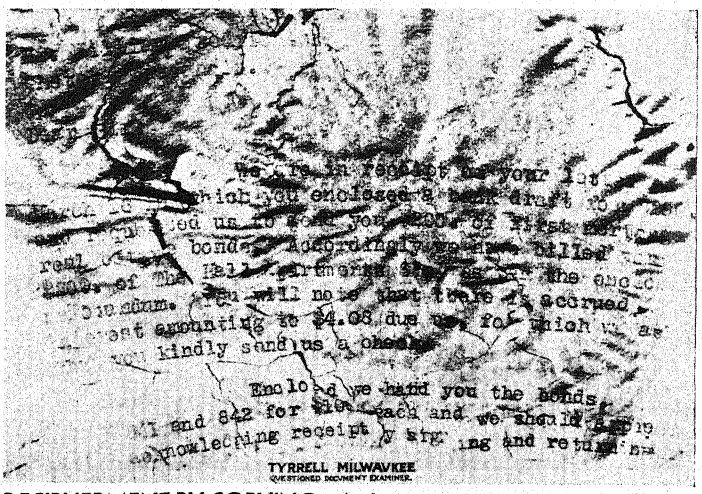
THE GHOST LETTER

August 9, 1915, was an exciting day for the town of Ladysmith, U. S. A. Jennie McCormick's agonized screams aroused the neighborhood. She had taken poison. Followed the neighborhood comment: "Arthur had a hand in it."

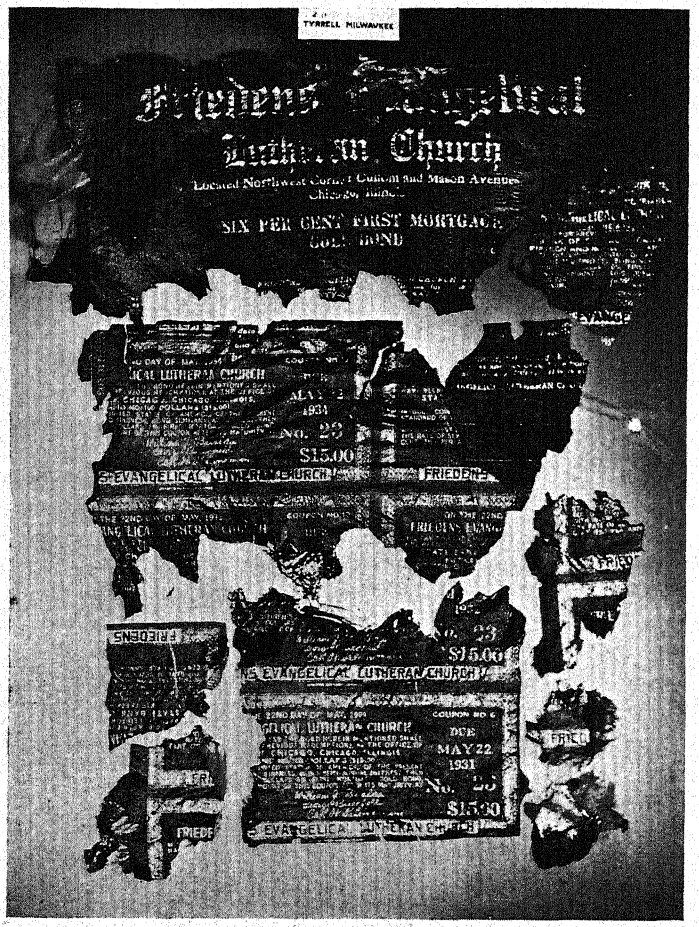
Sensing that he was suspected, husband Arthur proceeded to supply an alibi—a suicide note. Now of all things, one of the most difficult is to give a legitimate birth to an illegitimate document. But this is Arthur's recital of how he came into possession of what came to be known as the "Ghost Letter." Jennie, he stated, appeared to him in a dream. This to Arthur, having spiritualistic tendencies, was of great import, and, of course, perfectly reliable, for on moving a center table to look under the carpet as directed in the dream, a writing tablet fell on the floor, the upper sheet of which though blank, nevertheless showed a readable impression of writing from a missing leaf. And here is the message:

Aug 9, 15

Dear Artle
i Will son be
g on i cant stand
this pain
dont wory you
will be better of
good by Dear
Jennie
i cant get wel
god will for give me



DECIPHERMENT BY COPYING. A document camera, commercial film, and a blue filter produced this readable print of a charred letter. The technic of copying is, of course, extremely important in the investigation of documents with photography. For data on the technic of copying, see article entitled *Copying*



COPY BY REFLECTIONS. This charred document was photographed by making use of the different reflective powers of ink

For a photograph of the ghost letter, see page 2161.

(*Continued on page* 2161)

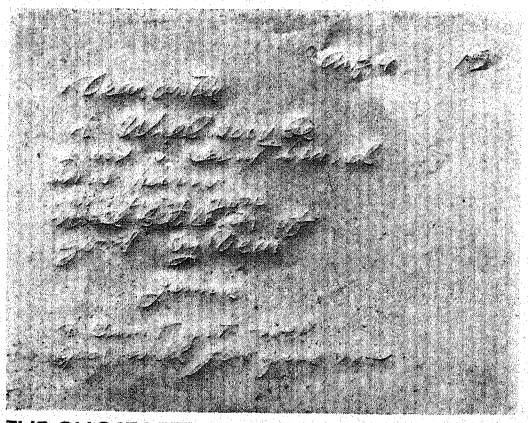
INVESTIGATING DOCUMENTS WITH PHOTOGRAPHY
(continued)

Arthur lost no time in having it photographed and copies distributed. The coroner held two inquests: the first verdict suicide, the second a John Doe homicide, for the women of Ladysmith had their own interpretation of the tragedy.

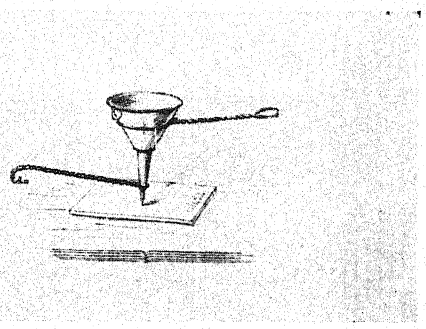
Arthur, a complete moral and financial failure, had seen Jennie's portrait some months previously and, upon learning that she was a wealthy widow, exclaimed, "That's the girl for me." The courtship was successful and things began to happen.

A joint bank account consisted of her $6,000; he withdrew the deposit, went to Oregon, and filed suit for divorce to head off arrest. She speeded after him, forcing him to return. Next the interested neighbors heard the reverberations of many a row, loud and profane language, a heavy body bumping down the backstairs. Hence, when the poisoning came to cap the climax, they had something to say at the second inquest, which returned a verdict of homicide at the hands of one John Doe.

But they did not then know that Jennie had asked her lawyer to draw a will in Arthur's favor, and, on his declining to comply, had gone to Arthur's attorney just a week before her death. It was shortly thereafter, at an early stage in the investigation, that the suicide note was brought by



THE GHOST LETTER. The McCormick case of 1915 hinged on a pseudo-suicide note, the impression of which was "planted" by the real murderer. To get the indentation, reverse the photo



TESTING PRESSURE. In the McCormick case, in order to test the pressure necessary to make the indentations shown on the "ghost letter," 3 lb., 6 oz. of lead shot was put into the funnel above the pencil. The murdered person's regular pressure was found from other letters to be only 6 oz.

the District Attorney for investigation, with numerous specimens of Mrs. McCormick's writing.

Arthur, as part of his alibi, had been forced to put his wife's will in probate. Then it occurred to him to enlarge upon the carpet note dream message. While the hearing on the will was in progress in county court, a man sent to remove the nailed-down rug in what had been her bedroom, rushed into court with another note which he said he had found under the carpet. It was a strip of paper containing two lines in pencil taken from the bottom of a page, notepaper size, and read: "you are not to blame for anything i took it all alone." McCormick had found among her papers the pencil copy of a letter to her lawyer, a sentence of which he had ingeniously altered to meet the emergency. This second attempt at suicide note writing and the expert's exposure of the impression as a transparent fake, brought about McCormick's arrest and trial for the murder of his wife. He was convicted and sentenced to life imprisonment.

The impression note, called the ghost letter, was indeed a clumsy fake. It was an artificial impression of a writing upon a missing upper sheet of the tablet of paper, but so heavy had been the tracing pressure that the imprint went through five of the sheets. Obviously the ghost letter was nothing more than a tracing by means of a

stylus, or point of some sort, of the words of a composition letter. Some of the letters and parts of letters, of the absent upper sheet, were missing. Of small *i*'s, only four were dotted; a letter in one word was missing, a *t* was uncrossed, and some of the impressions were not good patterns of Jennie's letters. To show the dead weight necessary to penetrate five sheets, a pencil was fitted into the spout of a funnel, a heavy wire loop supporting. Into the funnel lead shot was poured to ascertain the measured dead weight of a standard pencil mark. Six ounces of shot was found sufficient to equal Jennie's normal pencil writing, but to penetrate five sheets of paper, 3 additional pounds were required. When the bottle containing the three plus pounds of shot was passed by the witness to the jury, the first juror in his surprise at its weight nearly dropped it.

The case had an unusual flareback six years later. Having secured a new trial on grounds of newly discovered evidence, McCormick's lawyer sent for a letter from her sometime lawyer, that Jennie, in her lifetime, had written about trouble with a tenant. This odd request induced the lawyer to read the letter before complying. The source of the carpet note was at once disclosed. There, in her original letter addressed to her attorney, the latter found that she had written "i am not to blame for anything i told you all about it." Mrs. McCormick, though illiterate, was a good business woman, keeping a pencil copy of her business letters. It was from the copy of the letter to the attorney that Arthur had taken the carpet fragment, had altered it, and put it under the carpet to be found later.

When McCormick heard the letter read in court as the final evidence of his guilt, he seemed to wilt in his chair. Remanded to continue his term, he died within the year.

TECHNICAL DATA

Focusing. For copying in actual size the lens should be at twice its focal distance from the groundglass and the object at a similar distance from the lens. For enlargement:

a. Lens-to-subject: *divide* focal length of lens by times (enlargement factor) and add one focal length.

b. Lens-to-plate: *multiply* focal length of lens by times (enlargement factor) and add one focal length.

Example for a 4-diameter enlargement with a 10-inch lens:

$$\text{Lens-to-subject distance} = \frac{10}{4} + 10 = 12\tfrac{1}{2} \text{ in.}$$

$$\text{Lens-to-plate distance} = (10 \times 4) + 10 = 50 \text{ in.}$$

The groundglass image must be sharpened before the lens is stopped down. The required extensions may be marked on the camera bed for future reference.

The film holder should be tested to see that the film registers at the same depth in the holder as the groundglass does in its frame. To measure, remove the frame from the camera and, with a ruler laid edgewise across the frame and having a pendant pasteboard strip gummed to its side, ascertain the exact depth by pushing the card down until it touches the surface of the groundglass. Place a film in a holder and use the ruler and attached card in the same manner as for the groundglass, to measure the depth from the outer side of the holder to surface of film.

The groundglass supplied with the camera will be too opaque to admit of exact observation of the image, which should be done with a focusing glass. The obscurity may be overcome by affixing a microscope cover glass upon the ground side with a drop of Canada balsam. If the groundglass is first heated, the balsam will flow evenly and complete contact is ensured. Similar peepholes should be arranged at intervals; in the center, near the corners, and in the intermediate spaces. Focusing should be done through the intermediates, lens wide open. If a filter is added, re-examine.

Lighting. Correct lighting is of prime importance. The constancy of artificial light is its recommendation. The intensity diminishes in the ratio of distance from the subject. A moderate, even lighting from an angle is best suited to document photography. A moderate light yields better definition. Even lighting is essential to a good printer film.

Light from an angle yields the best definition and will include the grain of the paper, hall mark of the expert.

Stopping down the lens gives depth to the print. A good copying lens is not necessarily

a fast lens. Moderate, even lighting and longer exposure, all things considered, will produce best results. For copying faint pencil lines the light should be placed at nearly twice the distance as for ordinary copying, with wider aperture and increased exposure.

An exposure book of all experiments should be kept, giving date, subject, film, filter, time, light source, light placement. An intelligent use of the light meter will save time and material.

Enlargement. A scale in fractions of an inch placed on or next to the object will register the exact degree of enlargement.

A useful time exposure chart for enlargements:

Diameter	*Times*
1	Normal
1½	1½
2	2¼
2½	3
3	4
3½	5
4	6½
4½	7½
5	9
7	16
9	25
11	36
13	49
15	64
17	81
19	100

JEWELRY PHOTOGRAPHY

Rolf Tietgens
Photographer

The unusual reflection problems and the question of setting are important in the photography of jewelry. Like all specialized photographic fields, this one has interesting ramifications of technic—and they are described by a photographer who has made pictures for jewelers like Paul Flato of New York. The kinds of lights and backgrounds are particularly treated.

All photos by Rolf Tietgens.

See Also Fashion Photography, Glass and Silverware Photography

JEWELRY AND PRECIOUS STONES are costly and are artistic creations. The more expensive bracelets or necklaces often exist only as one specimen whose form and design is not repeated. So the photograph of a piece of jewelry should not only capture the material qualities, but also the richness and rarity, the artistic combination of stones and diamonds, as well as the idea of the designer, the feeling of form, and the purpose. These are difficult problems, especially where the colors of the different materials, which add warmth and life to the jewel, have to be abstracted into black and white. That means the soft warm color of gold should be distinguishable from the harder but still warm appearance of platinum into which diamonds and stones are set. And again one should be able to recognize the differently colored stones in a picture. This is not always possible, but one should strive to get as close to it as one is able to. The great danger is that all lightly colored materials will look alike, namely dead white with black shadows. To overcome this fault various things can be done, as will be explained later on.

The usual procedure is to photograph jewelry as a document in the way one photographs a painting or other artwork, namely to make a reproduction as near to the original as possible. The photographer will strive to show the workmanship, form, and design of the jewelry, the setting of the stones, and—if he is able to—a clear distinction between the different materials. The background is usually kept dark and plain. The lights are put right and left; the camera is placed right in front or straight above the object, avoiding all angles. These pictures are correct reproductions, but usually they are terribly dull and flatly lighted. A black and white drawing would in most cases do better, because reflections and overbrightness of certain stones then offer no problem. For just these reasons many manufacturers prefer drawings for their advertisements.

But it is possible to eliminate these faults and at the same time there are ways to present jewelry in an interesting and fascinating way in photography. The photograph must present the article in such a way that the spectator will wish to possess what she sees on the picture. So the necessity arises of creating in the photograph the feeling of richness and magical attraction which jewels possess—for instance the enchanting ardor of diamonds in a setting of warm gold and platinum-held rubies. The exact material qualities become secondary if it is possible to

create a dream of treasures from the "Arabian Nights" in the future customer, a perception of the uniqueness of a single piece in its elaborate elegance and costly splendor.

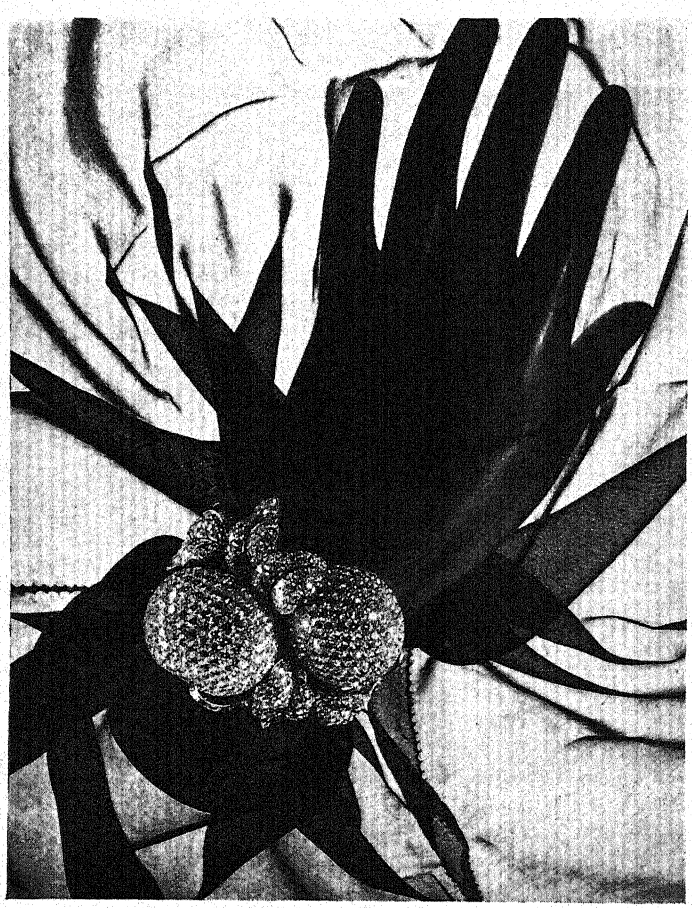
All this can be done in a photograph and the key to it is *light*, feeling for form, and imagination. Maybe patience should be added, because patience in this close-up work is one of the main factors in a satisfactory picture.

LIGHT AND BACKGROUNDS

The first rule for almost all jewelry photography is that strong lights are useless. No spotlights are necessary and No. 1 and No. 2 photoflood lamps are plenty. The next thing to observe is that gold, platinum, diamonds, and the colored stones all act in a different way to light. Since most pieces of jewelry are comparatively small, the problem arises of how to keep the lights from becoming too strong on the diamonds, which already in dim light shine very strongly, and at the same time prevent underexposure of the darker stones and metals or of parts that are in the shadow. Lightening the shadows in these small objects usually also lights up a new plane in a cut stone, creating a new reflection.

There are two ways to get around this difficulty: one is the choice of the background; the other is the use of a small mirror. Shaving mirrors are very useful since they can be applied in two ways, as a concentrating light source and as a plain light reflecting agent that is stronger than white cardboard.

For a background black is only good with pieces that have little variety in color, many diamonds, and small planes of metal. Red and gray and any light colors are useful. Best is red velvet, which results in a fine rich gray on panchromatic film. Velvet is good because of its light-reflecting qualities. These medium- and light-colored materials reflect light to brighten up those parts of the shadows that cannot be reached by mirrors. It is rather difficult to point the mirrors. The main light source lights the whole set with equal strength, but the diamonds will appear too bright because of their great reflection power. The mirrors have to be pointed to those parts that should have more light, as for instance, colored stones. This is where patience comes in. To make the shape of dark cut stones visible in the picture it is sometimes necessary to think of all kinds of devices—as suspending a mirror from a string to get a reflection at the right



It is often difficult to photograph jewelry on actual models, because a hand—for instance—is either so perfect that it will compete with the jewel or so lacking in perfection that it will detract from the general air of elegance. Here a stylized background and a dummy hand are used



The pin, in this case, has been propped a fraction of an inch above the print background, thereby gaining a feeling of depth. This feeling is enhanced by the low angle of the lighting and long shadows cast by the pin

point, fasten them on a pile of books, clamp them to a back of a chair or to a lampstand at various distances from the object—to control the strength of reflection. And if you are through with getting four or five mirrors into the right position you may accidentally move the light and you can start it all over again. Of course, one can use several lights and fewer mirrors, but the light easily becomes too strong and spreads over too great an area, creating many uncontrollable reflections.

Not only diamonds reflect the light strongly. Sometimes reflections from one material to the other create a great confusion of forms and light spots. Then only the softest indirect light is helpful. One even sometimes has to apply putty with a fine brush to some parts of platinum or gold. This has to be done very carefully because, when dried in the heat of the lights, it is hard to clean away from these small areas especially if smeared over tiny diamonds or in corners of the stone settings.

Gold in particular is very difficult to handle. On dark backgrounds it shows black reflections that make it look like highly polished chromium and on light backgrounds it appears like brass or worse. Red is very satisfactory as a background and so is cotton. It diffuses the light and so does a white veil folded several times loosely. A kind of stage out of white cardboard or cloth may be built around the setting, leaving only one opening for the lens. The illumination will be very soft if the lights are pointed against the white walls of the stage and not directly towards the object. Here the small mirrors can be used to bring highlights on parts of the jewelry that are too dull.

One important thing is to see to it that the jewelry appears plastic and that the illusion of space exists in the picture. One should feel like picking the jewel out of it. It is good to rest the object against a little pedestal, a match, a nail, or whatever is handy—to lift it from the background. Of course one must not be able to detect this in the picture. The lights should be pointed from a fairly low angle that will give the effect of greater depth. But the shadows should be watched carefully, so that no details are lost there.

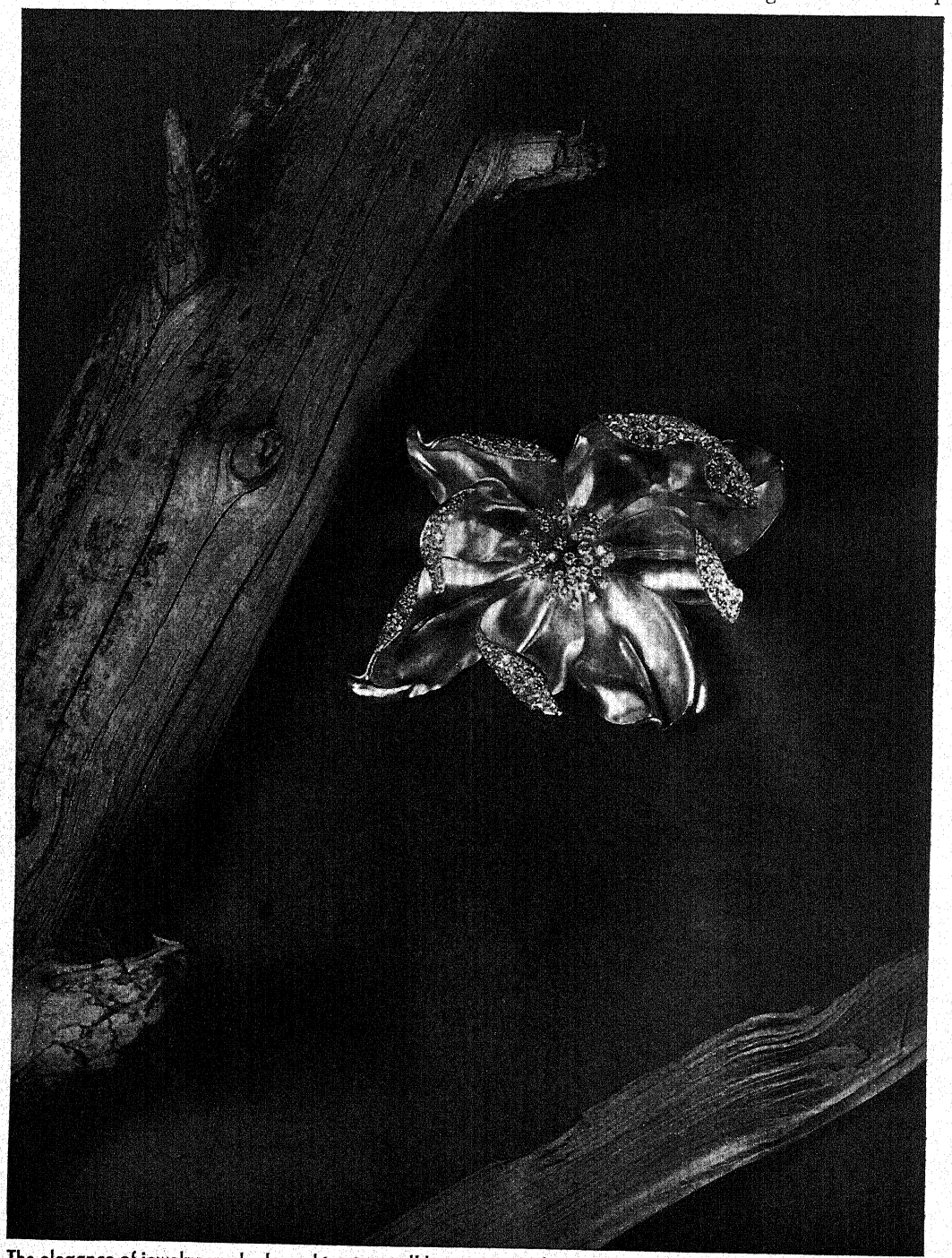


Here is simplicity itself in jewelry photography—with the set-up consisting of two feathers and simple mesh cloth. The feathers have been used to give the most elementary of design repetitions

Never must the feeling of weight or heaviness occur. Preciousness, delicacy, and costly tenderness must be retained—yes, even intensified.

SETTINGS

An imaginative background is very important in attracting attention and keeping interest. A model is not so good in a close-up



The elegance of jewelry can be brought out as well by contrast as by association. The dead, dull, yet interesting tree stump is nicely opposed to the twisting, brilliant piece of artificial beauty

picture in which the task is to show the jewelry in detail. One may of course, use the hands of a model, but one has more leisure figuring out the best lighting on these small objects if they cannot move. But there are ways to obtain the effect of a model by arranging the jewel on an enlargement of a photograph of a girl as a background. It is possible to put the jewel on this photograph in very unusual ways and so create a surprising effect. Very often the ideas for modern jewelry are derived from forms of nature —flowers, fruits, leaves, feathers, stars, etc. This leads the mind easily to associations which will lay the foundation for a nice background idea. The object always should appear as a part of the background, and at the same time be the important center of the picture. The eye is attracted by the whole arrangement but always wanders back to the center of interest—the jewelry. The background should be an enchanting one, intensifying and underlining the form and beauty of the jewel, suggesting a world of unreality and fantasy from which the object stands out as something one can take into one's hands and possess in a materialistic way. This does not ask for complicated or overcrowded settings. On the contrary the entire arrangement should be kept as simple as possible.

Your approach will, of course, be governed by the use to which your jewel photograph will be put. For catalog, advertising, or general editorial use there will be slightly different points of departure. But jewelry is essentially a luxury item and that impression should be given, regardless of the medium through which your picture reaches a buying public.

For instance, with a jewel resembling a blossom, some branches, strangely formed wood, maybe an enlargement of clouds in a blue sky could be used. Old etchings and prints having a character of elegance and dreamlike unreality make fine backgrounds. But in general all this has to be left to the imagination and taste of the photographer. The main thing is: concentrate interest on the jewelry, control light which should be fairly subdued everywhere around the main object, and get simplicity in the conception of the entire picture.

JUXTAPOSITIONS IN PHOTOGRAPHY

Barbara Morgan

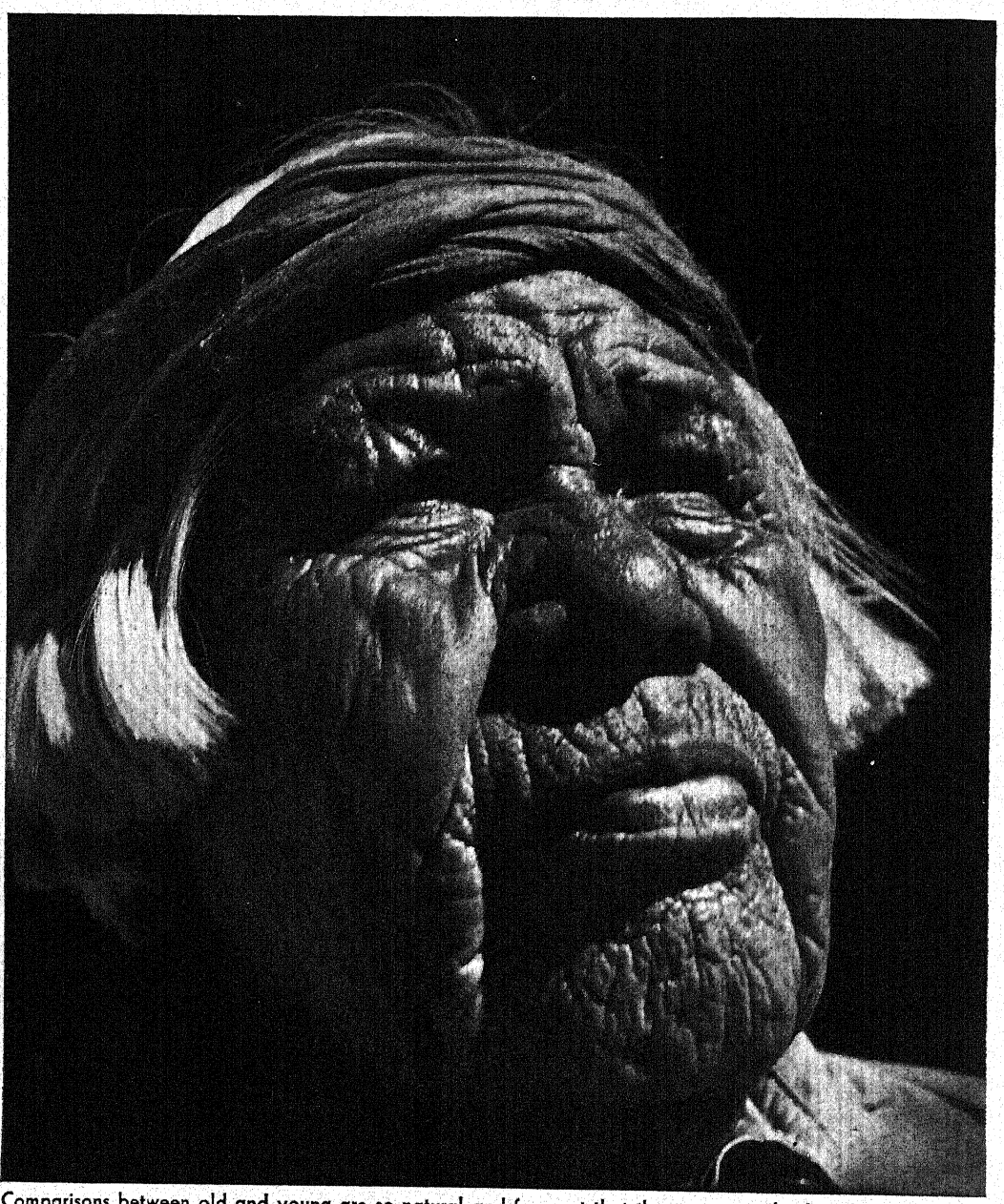
Dance photographer; Author of Martha Graham: 16 Dances in Pictures

By mental associations or actual associations of design, two pictures which are placed side by side can often take on new meaning or power. Such juxtapositions, when carefully thought out, can be effective and here are a few suggestions which will give your photography a new dimension.

See Also Montage in Movies, Photomontage

A PHOTOGRAPHIC juxtaposition is usually a collision of mental associations resulting from a collision of pictorial values. Strike flint with steel and a spark leaps. Match up picture with picture to bring out a spark of wit, a spontaneous laugh, a recognition of irony, a play of design, a deepening of meaning and you have what is currently called a picture "juxtaposition." Shock value is usually a first ingredient to jolt the mind out of accustomed grooves in order to grasp a new relation. Especially in caricature and visual punning the comparison is best driven home with exaggeration and distortion, else the pictures remain merely casual photographs with no fresh pictorial unity or idea impact.

There is nothing new about juxtaposition, nor is there any way to make a hard and fast rule about what is not a juxtaposition. Actually, any neighboring pictures are juxtaposed, that is, placed near one another. In exhibitions the pictures to right and left of yours can be damaging or helpful by their juxtaposition. In publications, the juxtaposition of the illustrations with advertising pictures is often amusing or annoying. Such juxtaposition is accidental and pointless. Here we use the term in the specific sense of a consciously chosen pair or small group of pictures which, by their peculiar rightness together, make a unified pair or group and give a new significance which none could have yielded separately. It should not be confused with reportage which is a more extended treatment of a theme in a more or less connected picture progression. Nor should it be mistaken for montage which unites the various images organically in one design. Usually juxtapositions are not narrative, but

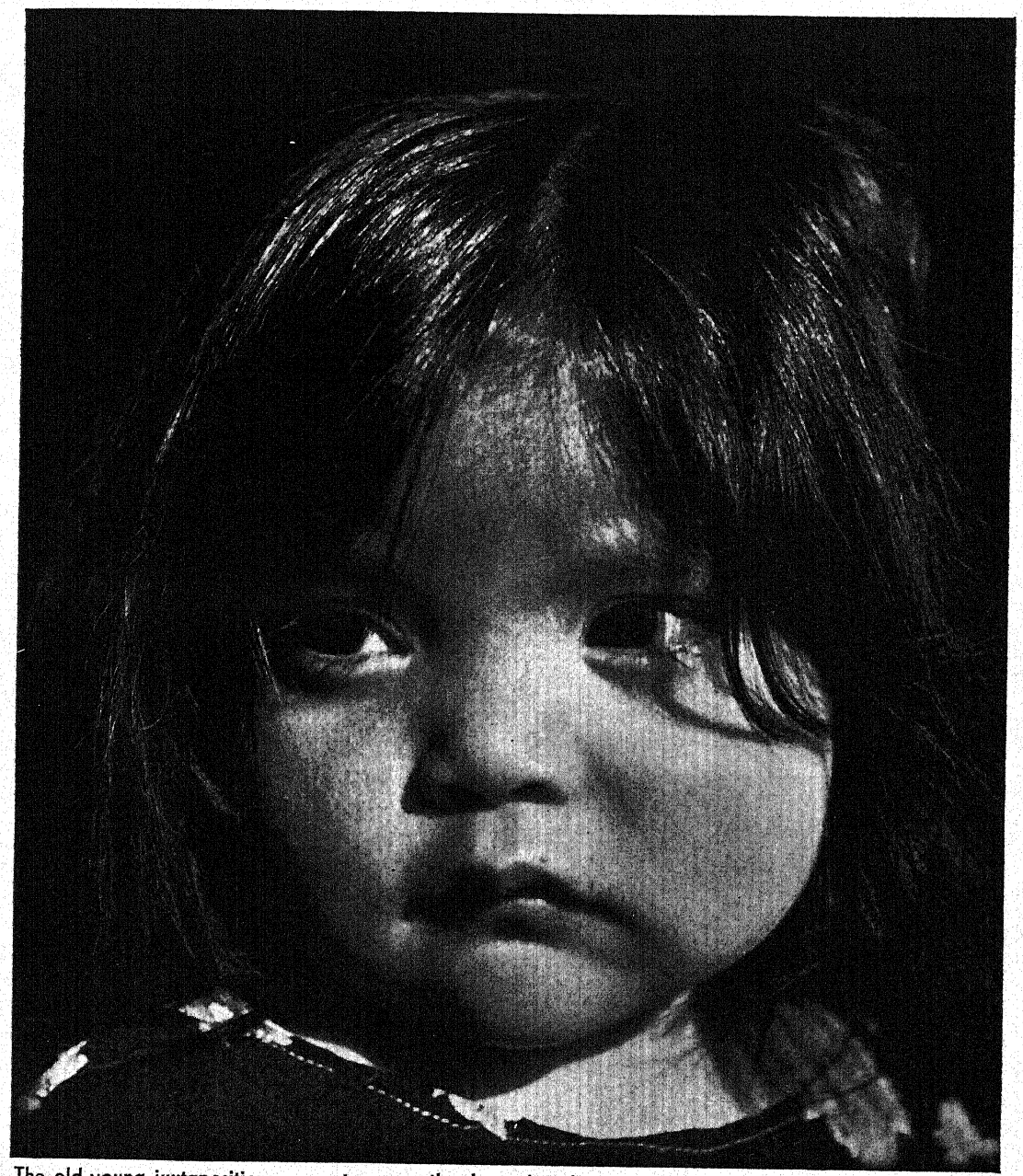


Comparisons between old and young are so natural and frequent that they are scarcely thought of as juxtapositions. Here is a grand old seamed New Mexico Indian
Photo, Andre de Dienes

offer a trenchant or beautiful similarity or contradiction, a witty or ludicrous comparison.

When a child cries out, "You skunk" in play or temper, he is using a simple image juxtaposition. Comparison of humans with animals in form, gestures, and facial expressions is a favorite sport of picture editors. It is a commonplace how much the master resembles his own dog and how much we all resemble the great apes. By looking in the mirror you can pick your own alter ego in the animal world. Are you goggle-eyed like a frog, or stolid and aggressive like a bull?

From this threshold of juxtaposition used for fun, matching pairs of pictures can be

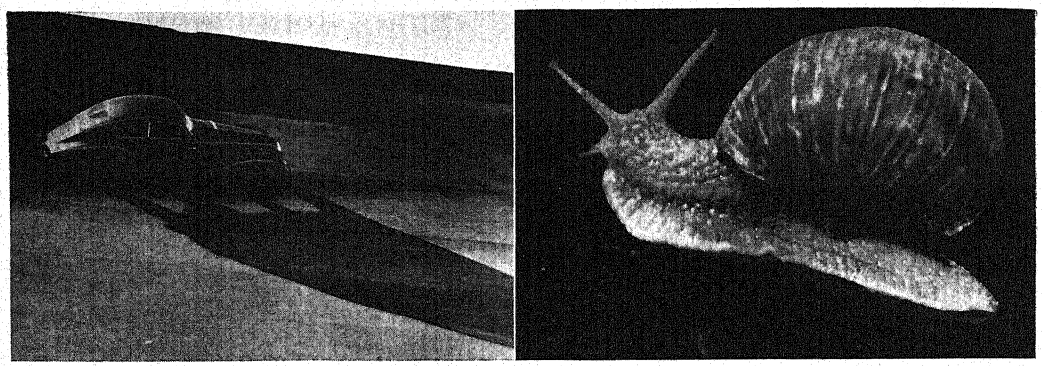


The old-young juxtapositions are not necessarily clever, but they are always absorbing. Here is a smooth-cheeked Indian child, showing the human face before facial forms are changed by age
Photo, Andre de Dienes

endlessly concocted which set up new meanings that neither picture could have singly. The meaning and flavor of a good juxtaposition should be within the eccentricities of the unique combination and should defy any attempt at an actual analysis, with overtones.

TYPICAL JUXTAPOSITIONS USED IN PUBLICATIONS

Many picture editors are avid juxtaposers. It follows that the photographer who submits his pictures is the victim or beneficiary of the editor's ideas and taste. To say the least, one's pictures sometimes go to press

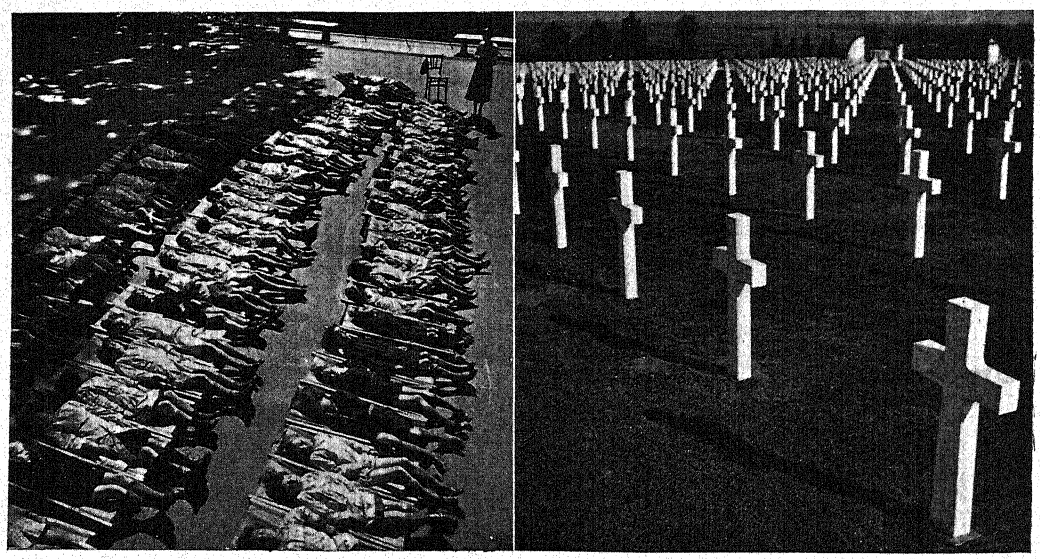


HIGH SPEED—LOW SPEED. Here is a neat pair which, at first glance, look well together. It is refreshing to see a monumental snail paired with a motor car. The oblique lines of the snail's body and of the car's shadow tie across harmoniously. Furthermore the contour of the snail's shell is surprisingly similar to the manufactured streamlined contour of the car. The extending horns of the animal help to tie the two pictures together. "Slow as a snail," the old figure of speech, is here the starting point for the literal illustration, and in juxtapositions of this kind, the success depends upon the observer's knowledge of such phrases. This juxtaposition depends upon the idea to carry it, for the car is not speeding convincingly

Photos, Rene W. P. Leonhardt

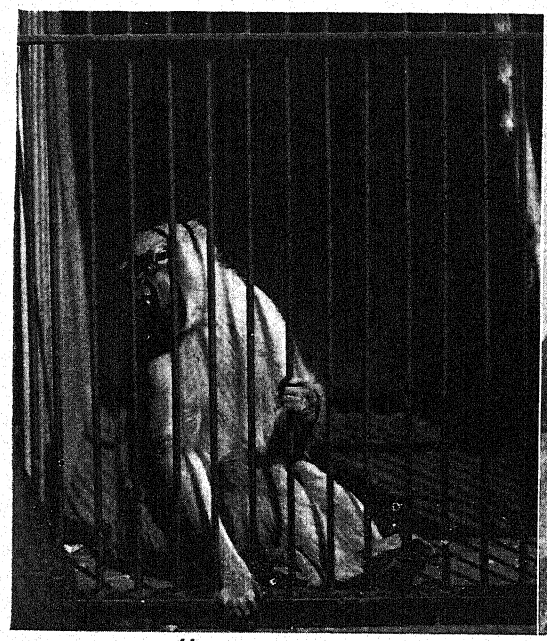
with strange bedfellows. By scanning a few past photo annuals from various countries, newspapers, magazines and illustrated books, I compiled a small list of juxtapositions to show the drift of editors' minds. Some juxtapositions are excellent and many are very banal and sentimental but harmless. Titling usually plays an important part in starting the mind in the right hook-up.

Laughing—Crying
Old—Young
Reality—Dream
Transparent—Opaque
Comparison of structures
Black—White
Fast—Slow
Summer—Winter
Stronger Sex—Weaker Sex



LIFE—DEATH. The living pattern facing the dead pattern makes a delicate balance between waking and sleeping, between sleeping and death. At one moment the matter-of-fact reality of children sleeping in the sun and the stark fact of once-living men now dead wheel over into the incomprehensible mystery of life and death. A thousand thoughts are stirred by this juxtaposition. So little would start the children laughing, chattering, and running; so little could take them into the soldier's fate. Linear forms, too, have relations—for the rows of children seem to be sliding precariously forward toward the rows of crosses, and the several apparent vanishing points among the crosses create a sense of ghastly movement

Photos from C. Angers & Co.



He wants to get out



He wants to get in

INSIDE—OUTSIDE. One wants to get out; the other wants to get in. This is the type of juxtaposition which depends heavily upon the title. It is suited to rotogravure use or for a very general audience, as it plays up the charms of a child and an animal—both top ranking in popular choice. The rear view of the little boy against the broad paling is a complete reversal of the front view of the animal behind the narrow bars

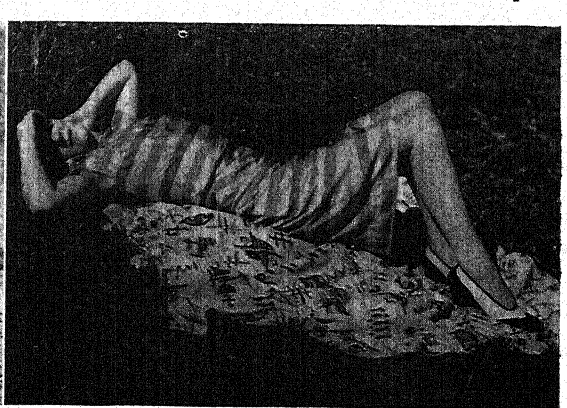
Photos, Rene W. P. Leonhardt

Overdressed—Underdressed
Round—Pointed
Prisoner—Liberty
Luxury—Poverty
Preserve—Destroy
Dwarf—Giant
Positive picture—Negative of same picture
Long shot—Close-up
Etc.—a thousand other synonyms and antonyms of forms and ideas.

CONSTRUCTION OF JUXTAPOSITION

What makes a juxtaposition work? It is natural for us to invest every picture that commands our attention with a cluster of mental associations. Involuntary images pop up. Pictures touch off the unconscious values we hold toward everything in the visual world—familiar and unfamiliar. Our hopes, loves, fears, commonly-held beliefs, prejudices, embarrassments, esthetic pref-



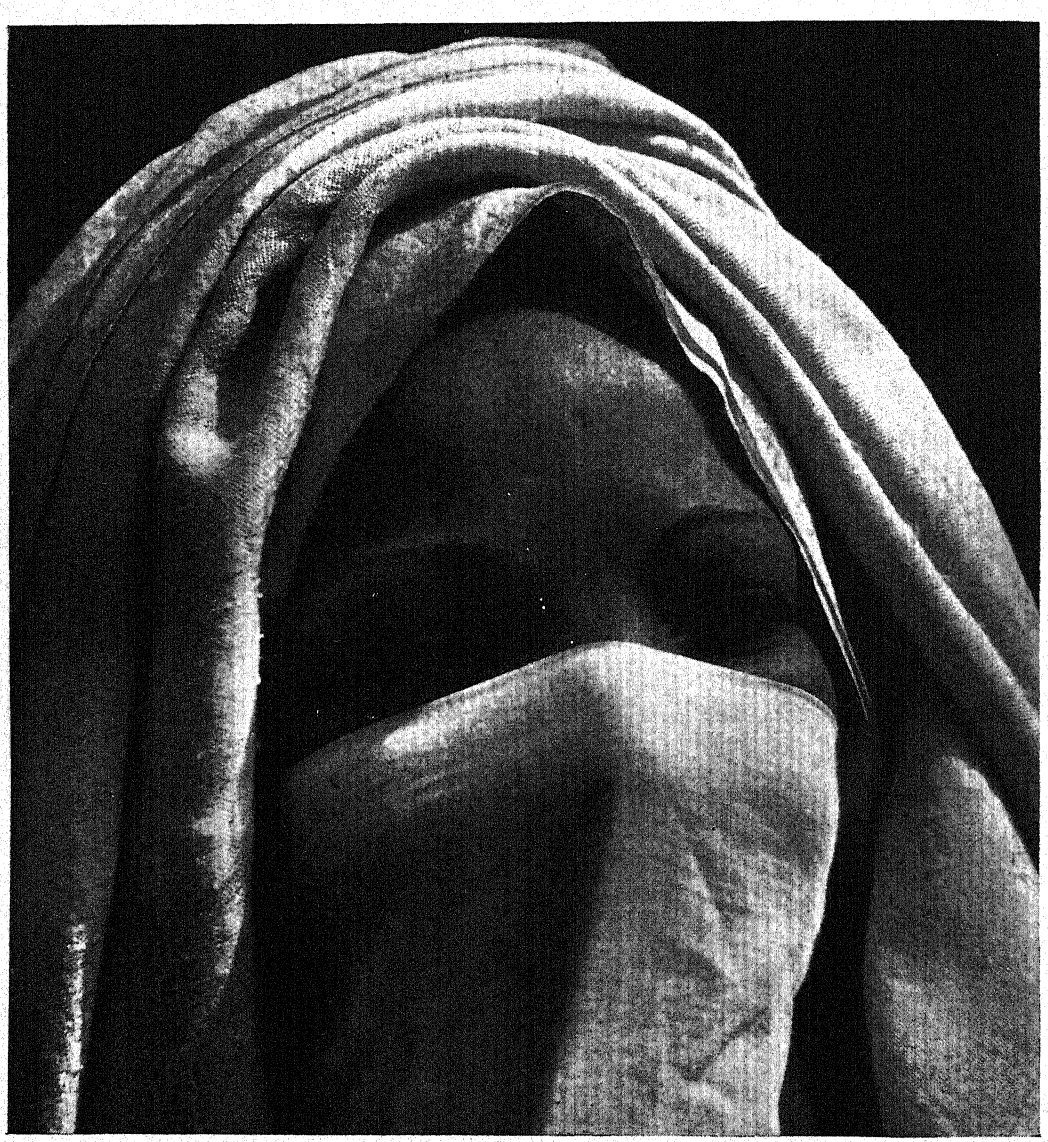


ANIMAL—HUMAN. Two striped forms are shown relaxing—one in zoo captivity and the other in the Sunday afternoon freedom of a park

Photos from Studio Reiss

erences are the strings we pluck in a juxtaposition. Most people love life, fear danger, like to see pompous egoists ridiculed, feel tenderness and amusement for children and little animals, enjoy seeing the bathing suits of 1890 alongside the bra and brief of today. Modes and manners, folkways, all the ephemeral values we passionately attach to our important present take on humorous perspective for a good laugh, or create pictorial comparisons of the times.

How does the mind work? Why are we insulted, intrigued, provoked to thought, surprised, inspired, depressed, esthetically moved? Here is where the collision comes in. When two pictures are brought together, they bring all their attendant associations and reciprocally lock horns. The more incongruous the pair is, the more we exert to unite them in our minds and to find common ground for their likeness or unlikeness. The degree of zest or refreshing disgust we have



EAST

The confinement of women of the East is forcibly pointed out by this close-up. The juxtaposition of this and the practically nude western woman is discussed in the text

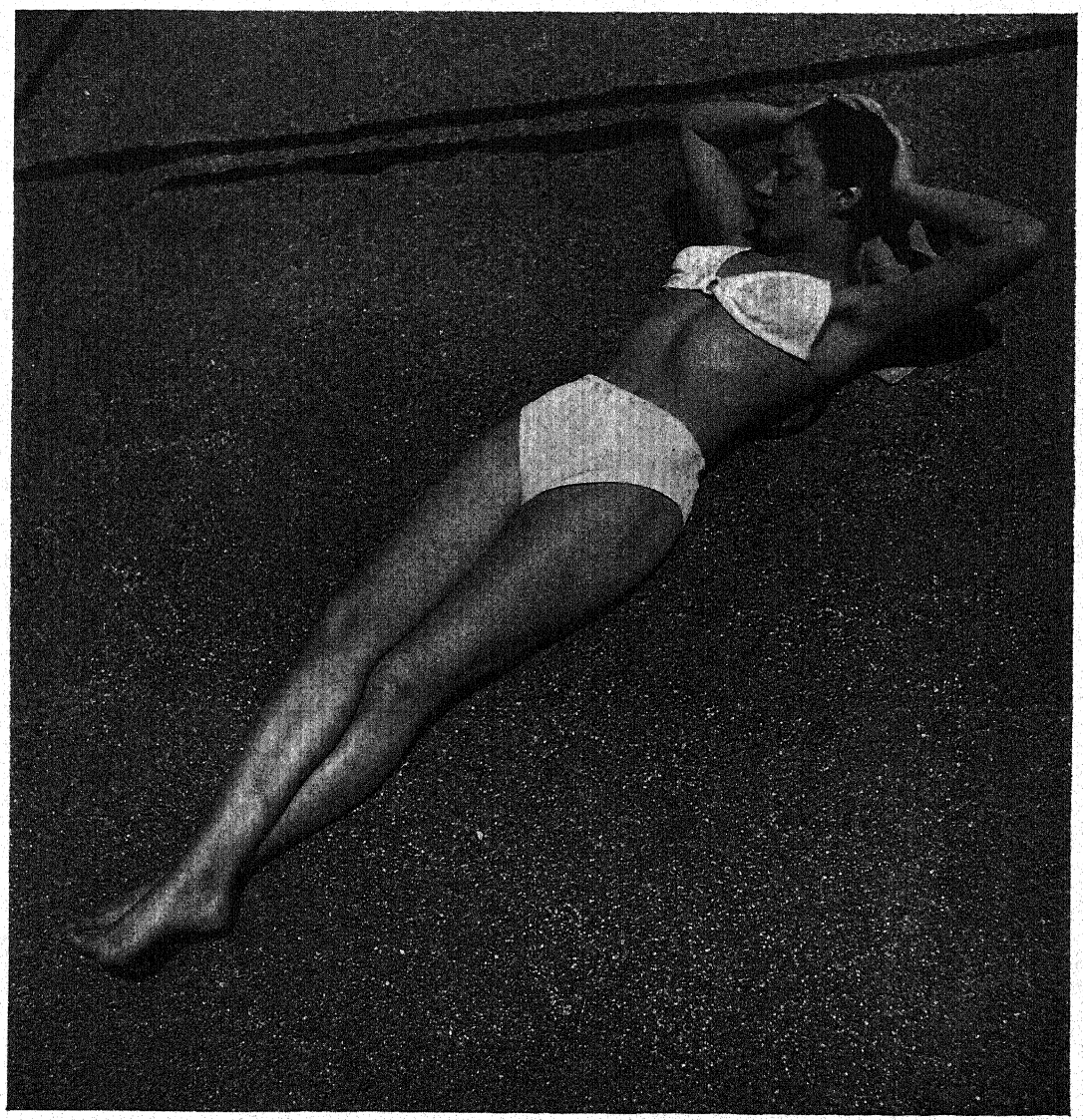
Photo, Andre de Dienes

for the job decides whether or not it is a potent juxtaposition.

Many juxtapositions in photo annuals do not involve meanings but are picture partners chosen to enhance one another for line, mass, texture, lighting, or other purely esthetic qualities. Journalistic combinations are often very dependent upon the title interplay. Still other juxtapositions without titles are able to galvanize the brain for experiences by sheer impact of forms and meanings.

ANALYSIS

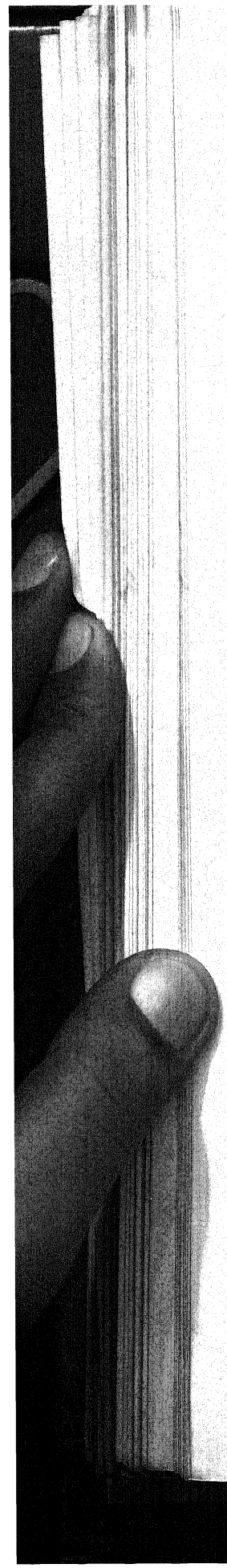
A juxtaposition should no more be taken apart than a well-mixed cocktail, as the whole point and flavor of it is in the "mix." However, to combine it oneself, the ingredients have to be known. Let us analyze the juxtaposition *East vs. West* (page 2172) which symbolizes the subjugation of women in the east and the freedom of women in the west. In this contradictory match there are two active contrasts in both form and meaning



WEST

The long view of this extremely scantily dressed European woman is nicely opposed to the photograph of the veiled women of the East. The freedom of women and social confinements are immediately called to mind

Photo, Rene W. P. Leonhardt



which jell as a juxtaposition. First we will break it down as to form.

The close-up of the Algerian Woman with the draping curves of the head, shawl, eyebrow curves, and the unfamiliar face cloth stretched over the nose, makes the substantial base of the two-picture relation. Against this upright swathed mass the nearly nude svelte figure springs away obliquely with a down camera angle. Lots of clothes vs. lots of skin . . . concealment vs. frankness and sunshine. The slanting direction of the sunbather and the dominant curve of the shawl unite to make a *V* in the twin picture layout. The well-modeled body is given clear sculptural relief against the sand granules of the middle gray background area. Shadow lines and the white shorts and bra accent the figure. Dark hair mass and lifted arms carry the eye upward into the long shadow lines which in turn tie the two pictures together.

While the eye plays over the balance and tension of the picture form, these two women who typify the opposed attitude of the old east and today's west toward sex and social modes start mental associations according to the observer's experience: the harem, the veil, the lingering sex atavisms undergoing a terrific shake-up in many parts of the East vs. swarming bathing beaches, nudist colonies, sunworshipers, Vitamin D, shorts and playclothes for women in our west. These opposed pictures vividly stimulate and clinch the differences with conviction as the eye moves from one to the other, building the entire concept.

FLEXIBILITY OF JUXTAPOSITION

One can split up matching pairs and recombine the same pictures in many new juxtapositions with still other partners. Fresh juxtaposition gives new energy and use to the same old picture, at a new pace. Picture agencies could not survive financially but for this flexible usefulness. The same picture is matched in one context and emerges again in another. The cracked liberty bell, for example, is a perennial symbol paired with everything from life insurance, to breakfast food, to a dignified statement of history and freedom.

Art editors do not have a monopoly on creating juxtapositions. Many professional photographers have a keen nose for them and are always making new combinations from their files. Amateurs can have great fun in the family album with visual puns via juxtaposition. For poster propaganda and political satire it can be powerful and excoriating, as a useful weapon for dramatic presentation in war or peace time.

Summing up, photographic juxtaposition is a direct form of picture editing by which the photographs step beyond their role as single frame pictures. The new unity by juxtaposition may achieve dimensions of significance limited only by the humor, imagination, and intelligence of the creator.

KALLITYPE. The kallitype process is a homemade medium for general pictorial printing, based on the fact that light will reduce ferric salts to a ferrous state, which will then reduce soluble silver salts to a metallic state. By this process, pictures may be made in various tints from sepia to black—on drawing paper, rough or smooth. It is essential, however, that the paper be pure and not impregnated with chemical salts.

Sensitizing. The paper is immersed for about 3 minutes in a sizing bath (necessary for soft papers) consisting of 2 grains of arrowroot to 1 ounce of water. It is dried and may be sized a second time before sensitizing in the following solution:

SENSITIZING SOLUTION

Ferric oxalate, crystals	75 gr.
Oxalic acid	5 gr.
Silver nitrate	30 gr.
Water	1 oz.

After filtering, apply the solution to the paper with a sponge or brush. The sensitizing should be done in weak artificial light, and it is important that the sheets be dried in the dark.

Printing. The paper is printed in a contact printing frame in daylight or strong neutral artificial light and the exposure continued until a faint brown image is seen on a yellow ground with detail just perceptible in the darkest parts.

Development is carried out in a solution of borax and Rochelle salts (sodium-potassium-tartrate) and the proportions of the developer are varied according to the tone desired, as follows:

Developer	*Sepia tones*	*Purple tones*	*Black tones*
Borax	—	120 gr.	1 oz.
Rochelle salts	½ oz.	1 oz.	¾ oz.
Potassium bichromate	3 to 4 gr.	7 gr.	5 to 6 gr.
Distilled water	10 oz.	10 oz.	10 oz.

Increased bichromate increases contrast in the final print.

A warm maroon tone may be obtained by developing in:

Sodium tungstate	1 oz.
Distilled water	10 oz.

The print should be left in the developer for 10 to 15 minutes after it has attained its full vigor, to be sure that all the iron salts are dissolved. There is no risk of overdevelopment if the exposure has been correct. The print is then fixed in the following:

Hypo	50 grams
Ammonia (.880)	12 cc
Water to make	1000 cc

After fixing for 10 minutes, the print is washed in running water for half an hour. It may then be toned, if desired.

KITE AND BALLOON PHOTOGRAPHY

H. H. Slawson
Free Lance Writer

This is the story of the first attempts at aerial photography—from balloons and kites. Begun by the well-known photographer, Nadar, the technic reached its peak in the stratosphere photography of Lt. Col. Stevens.

See Also Aerial Photography, Archeological Photography, History of Photography, George Lawrence, Nadar

THE FIRST RECORDED successful attempt at aerial photography was made in the summer of 1858, when Felix Tournachon Nadar, French artist-writer-photographer, rose in a balloon above the Parisian suburb of Le Petit Bicêtre and at 80 meters (262 feet) obtained on a collodion plate a bird's-eye picture of the scene below. In the five succeeding decades balloon photography attracted many practitioners, its eventual popularity being suggested by one enthusiastic statement that in Paris during the Exposition of 1900, "thousands of photographs were taken from captive balloons."

FRENCH BALLOON PHOTOGRAPHY

Nadar's resolve, when 38 years old, to "get photographic views of the earth at a certain height in the air" was accomplished despite the jeers of Paris scoffers (see cartoon, page 2008). Collodion plates were his biggest difficulty. They had to be coated fresh just before exposure, then be shielded from hydrogen gas which leaked downward from the balloon, causing unwanted chemical reactions. The problem was overcome by constructing in the "airship's" basket a darkroom of orange cloth re-enforced by a black lining.

Late one afternoon, after many repeated failures, Nadar ascended once more above Paris. The light proved unsuitable and he had drifted out to the country. So, coming down near Le Petit Bicêtre, he "parked" his balloon, "The Giant," under guard overnight. Next morning, still undaunted, he went up again and at 80 meters made an exposure.

"They drew me down," Nadar related. "I leaped out and rushed to the inn where, all excited, I developed my plate. "And then, triumphant, he emerged to show the results. Indisputably, though faint, the negative show the hamlet's three houses, a farm yard, the inn, even roof tiles, a gendarme, and a cart whose driver, in surprise, had drawn up right in front of his balloon.

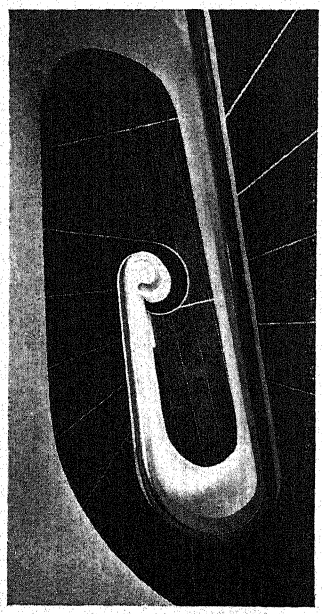
"I was right," he concludes. "Aerial photography was possible." Immediate capitalization on this success was, however, hindered by Nadar's need for daily bread. "When I was in the air," he explained, "my photographic business suffered." So ten years passed before he obtained a really faultless aerial photograph. Taken in 1868, it shows the Arc de Triomphe with its surroundings.

The succeeding chronology of balloon photography bears many illustrious names. Among early Frenchmen was M. Dagron, who in 1878 used the steam-propelled captive balloon of Henry Giffard and, after many trials, obtained at 500 meters altitude a "satisfying" picture of Paris from a collodion plate. "The distance is blurred," said one comtemporary commentator, "but one can distinguish a big part of Paris."

On June 8, 1879, another Parisian, M. Triboulet, with camera pivoted on the basket's edge to make vertical shots possible,

(Continued on page following insert)

COMPOSITION ANALYSIS for . . . STAIRWAY

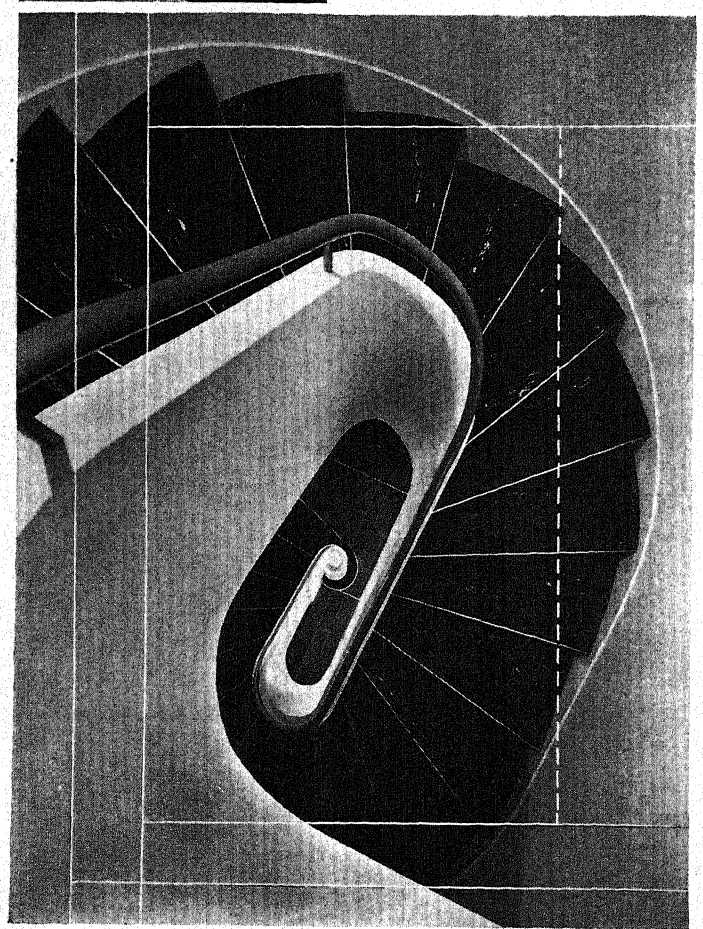


The downshot photograph of the irregular spiral stairway is an interesting subject for studying composition. Opinions will not be unanimous as to how good the composition is, or how much it can be improved by judicious trimming, but there is certainly a single theme of interest—that of the rhythmic spiraling of the stairway downward to the floor below, and one gets a conscious feeling that there is actual space at the bottom of the stair well.

Since the eye is always attracted most strongly to the area of greatest contrast in a picture, it is fitting here that the area of greatest contrast should be the brightly lighted portion of the balustrade and newel post at the bottom of the stair, next to the black stair treads. Vying perhaps too much with the newel post area is the top part of the white plaster railing that runs into the picture from the left edge. This could have been toned down a bit more in the darkroom when the print was made.

Although this picture has many strong lines, one does not get a feeling that the subject is a "busy" one because the lines are in orderly arrangement. A point of confusion is the flat lighting of the plastered wall at the left and lower part of the photo. It is hard to tell whether or not the wall slopes downward toward the floor below. Consequently, we can trim to advantage from the left edge a strip amounting to nearly a quarter of the photo. By doing this, however, we find it necessary to trim an equal amount from the right edge of the picture to retain proper balance.

At the bottom edge of the picture is a light triangular shaped area next to the dark shadow at its right. This is an eye catcher we can cut off to advantage, and while about it, let's cut a little higher to get rid of the intersection where the curve of the wainscot meets the slanting line of the plaster wall. By doing this, our eye stays in the picture area more easily.



But now another decision has to be made, because our attention goes to the top of the picture. This is because the bright curved line of the wainscot leads the eye up towards the left corner, thus counteracting the desired effect of inviting us to look down into the stair well. The remedy is to trim a slice from the top of the picture through the three top stair treads.

As a result of analysis and consequent trimming, we now have a composition which holds all our attention within the rectangle chosen without any tendency to wander toward the edges. Our eye runs automatically to the newel post at the bottom of the stair, but to get there it is led into the picture at the upper left edge by means of the baluster line. The diminishing width of the baluster and the progressively smaller areas of the stair treads also aid the feeling of distance and carry the eye downward. We are conscious of a spiral motion because of the delineation of the bright edge lines of the stair treads and also a bit unconsciously because of seeing the vestiges of the curve of the wainscot line still showing in the right upper and lower corners. The slant of the stair well opening is a powerful factor in making this photo dynamic.

NOTE: Another possibility for a good composition from this subject is that shown in the small figure. It does not give as good an idea of the stair construction generally, however, as the previous arrangement. *F. S. Lincoln*



STAIRWAY

F. S. LINCOLN

See the opposite page for the photographer's analysis of his own picture and for more on the photography of interiors, see his article on *Interiors—Home and Professional*



LORETTA YOUNG

WHITEY SCHAFER

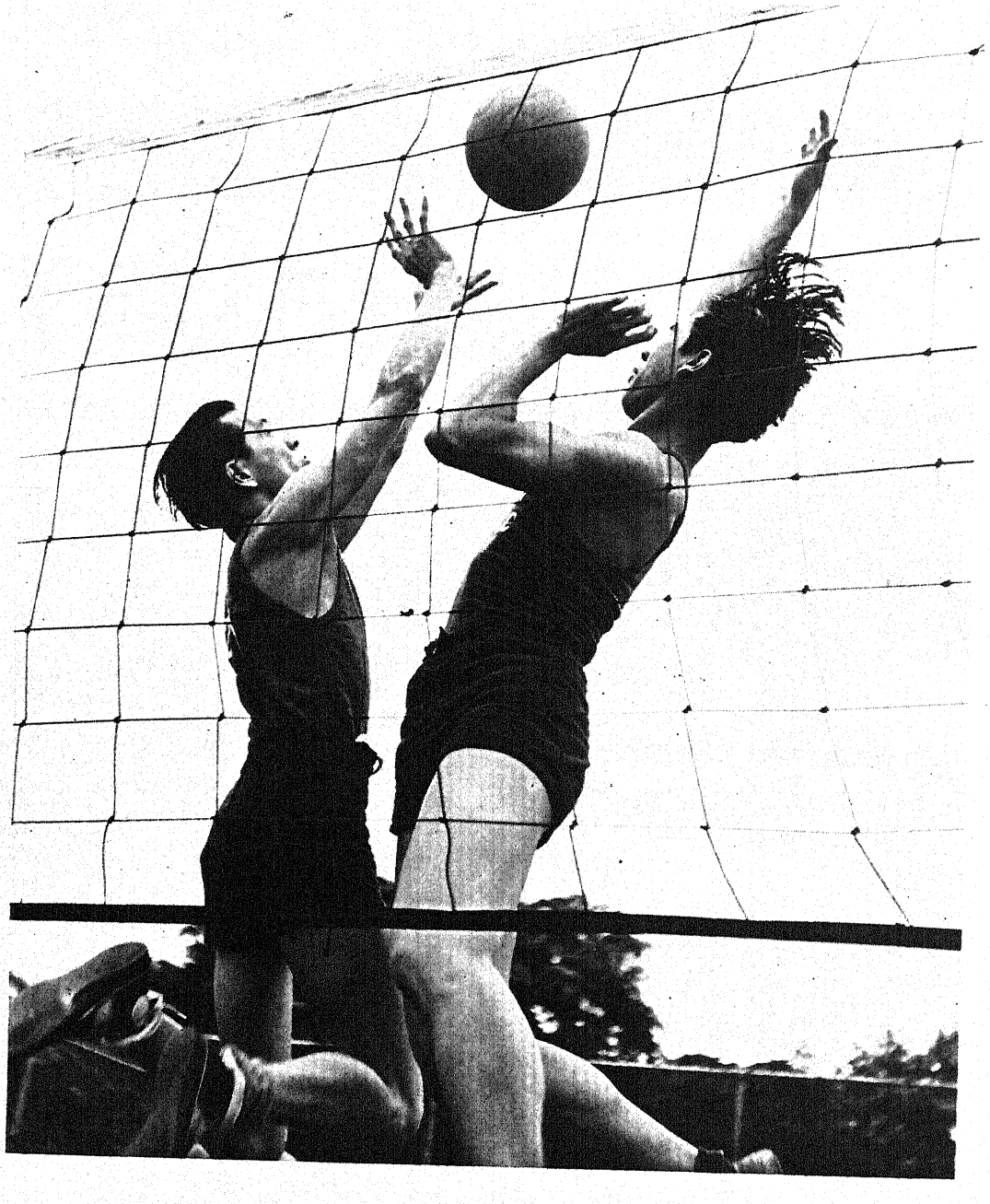
In the Second Annual Still Photography Show of Hollywood Studios, sponsored by the Academy of Motion Picture Arts and Sciences, this photograph was judged the best fashion study. It is a still from *He Stayed for Breakfast*, a Columbia production



ANNA NEAGLE

ALEXANDER P. KAHLE

Here is a prize winner in the Hollywood Studios' Second Annual Still Photography Show, judged the best action production still taken in a studio. This fine action photo of a graceful dancer was taken for the RKO Radio production, *Sunny*



JUMP!

JACK GARBER

Taken during a volley ball game showing members of the Chinese Youth Center in vigorous action. The net makes an interesting foreground pattern and also explains the locale. Notice that the exposure has been carefully determined so that the figures, though shot against the sky, would have shadow detail on the near side. DATA: Medium speed pan, 1/200, f/5.6. See article on *Sports Photography*

(*Continued from page preceding insert*)

exposed his plates from a free balloon at 500 meters. A sudden rainstorm "washed" him earthward and, barely missing Notre Dame's tower, he landed on the Seine, whence sailors rescued him. He had entered the city unlawfully, however—over the wall instead of through a gate. When authorities searched for contraband they opened his suspicious-looking black box and the precious plates were irretrievably spoiled.

In a free balloon, near Rouen on June 14, 1880, Paul Desmarets tried a new technic. Through a hole in the basket's floor, he projected his camera's lens to make vertical views at 1300 meters. To control the shutter of his inverted camera he adopted a device physicians used in administering "galvanic" treatments to their patients. Release of the current actuated magnets which permitted "regulation of time of exposure from the really instantaneous to a more prolonged pose." Desmaret was noted, also, for his first use of bromide plates in aerial work.

M. Triboulet appears again in 1884 as inventor of an aerial camera intended for operation electrically, either from the ground or in mid-air. Hexagonal in shape, the apparatus had six lenses for making horizontal views and a seventh lens for a vertical shot through the basket's floor. Records say results were never successful. Yet another invention contributing to progress was that of M. Cassé, director of the Gruby Observatory at Montmartre. Appearing in 1884, it was an attachment for aerial cameras operated electrically by remote control. As the camera's shutter closed following a mid-air exposure, Cassé's device released a paper streamer which floated away to indicate that the operation was completed.

Jacques Ducom, teaming up with the noted aerialist, Gaston Tissandier, comes next in the parade of French aerial photographers. On June 19, 1885, in a 32-minute flight of 11 kilometers over Paris, they obtained five unusually excellent pictures (see page 2010).

"You can count the chimneys, like little black points on the roofs," wrote Tissandier. He speculated on the possibility of making topographic maps this way and on the powerful help they would be to military men and explorers. Concluding, he expressed his conviction that "Aerial photography is on the threshold of a wonderful future."

AERIAL PHOTOGRAPHERS IN ENGLAND

In England, all this time, photographers with aerial ambitions were also active. In 1859 James Glaisher, president of the Photographic Society of Great Britain, ascended six miles in a free balloon. It was more than he bargained for and if his plates were failures, it was partly because the balloon rose so swiftly and spun around so fast and partly because he lost consciousness.

Cecil V. Shadbolt is the only English photographer recorded as successful in his attempts at aerial views in those early days. In 1882 he obtained five views of London and nearby countryside, which in next year's salon of the London Photographic Society evoked admiration and brought generous praise, as well, from French rivals. Fugitive English records contain also W. B. Woodbury's name as inventor, in 1881, of a balloon camera, weighing twelve pounds, to be operated electrically from the ground. In the camera was a revolving drum from which four plates could, in succession be moved automatically into position before the lens, as the photographer, watching through a telescope, waited for the favorable moment to press the key and release the shutter.

AMERICAN BALLOON PHOTOGRAPHERS

America's honor roll of balloon photographers is topped by J. W. Black of Boston. In 1860, with "Prof." Samuel A. King, noted Providence, R. I. aerialist as his navigator, Black used a wet collodion plate to obtain a picture of Boston at a height of 1200 feet. For years this was widely acclaimed as the most successful aerial photograph on record. Oliver Wendell Holmes immortalized it with the phrase, "Boston as the eagle and the wild goose see it."

In May, 1862, during battles around Richmond, Va., General George B. McClellan used balloon photographs to advantage. From these pictures, made by one Allan and his aeronaut, La Montain, huge maps of the terrain were prepared and marked with 64 squares. Then, while the Union commander at headquarters scanned one, the movements

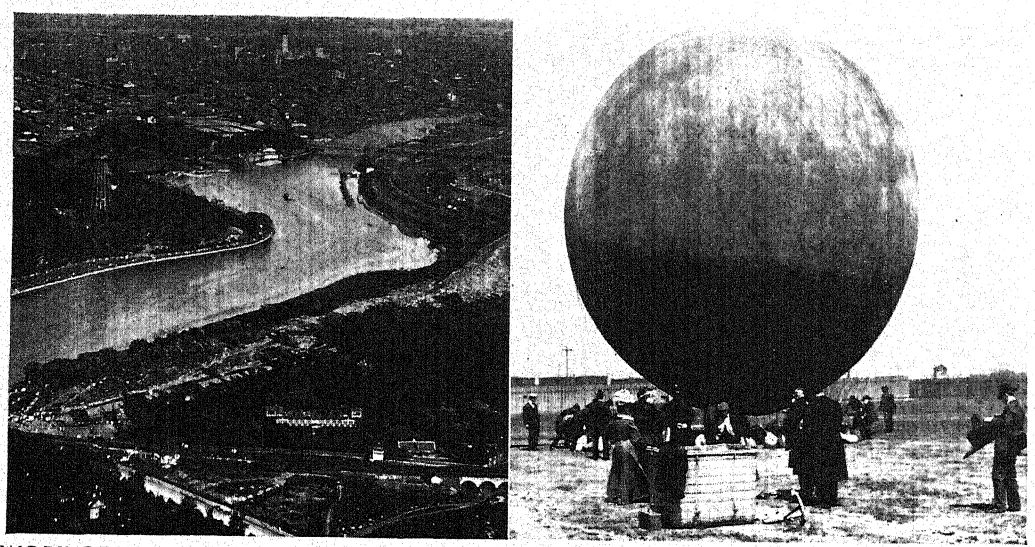


BLACK'S VIEW OF BOSTON. Taken by J. W. Black in 1860 from an anchored balloon. This print was made from the original wet plate negative
From American Museum of Photography, Philadelphia

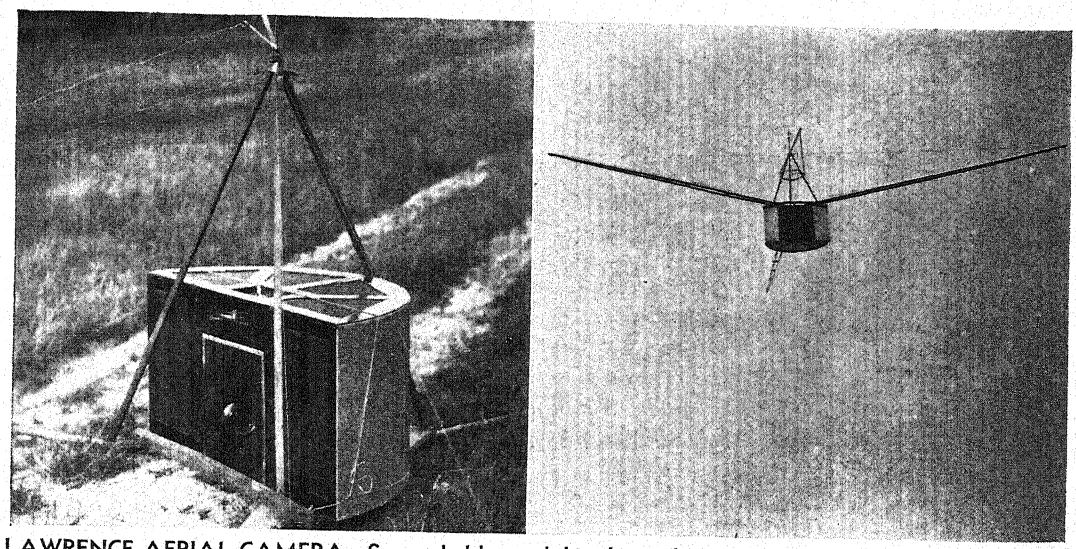
of the Southern armies were reported to him over a telegraph line operated by observers in the balloon.

Following Prof. King's Boston experience with Black, more than a score of air-minded photographers used his many balloons in unsuccessful efforts to get aerial photographs. It was thirty years later, in 1890, that the reason for so many failures was determined. Studying results of these early American experiments, W. N. Jennings, Philadelphia photographer, concluded, "When the light of the sky floods the landscape, the quickest shutter speed is far too slow for a wide open lens and instantaneous plate." Jennings, accordingly, stopped down his shutter, used a slower emulsion and a yellow color screen. With King as his navigator, he immediately began getting truly remarkable views of Philadelphia and its environs. His plates were small, but even when enlarged to 24 x 36 inches, the prints, as Jennings points out, "had all the qualities of a rich steel engraving . . . without a fuzzy line."

Balloon photography, after struggling half a century, had at last "arrived," but only a brief time remained for enjoying its triumphs. Almost while Octave Chanute in Chicago experimented with the gliders on which the Wright boys later flew to fame, another Chicagoan, George R. Lawrence, was active as the last great balloon photographer (see article on *Lawrence*). In spite of the advent of the airplane and aerial photography, however, balloon photography has



WORK OF W. N. JENNINGS. At left is the first known photograph taken in America from a free balloon. It was taken on July 4, 1893 over Philadelphia by W. N. Jennings, and an ortho plate with yellow filter were used. At right is Jennings with his first reflex camera preparing for a flight in the *Philadelphia II*
Photo from American Museum of Photography, Philadelphia



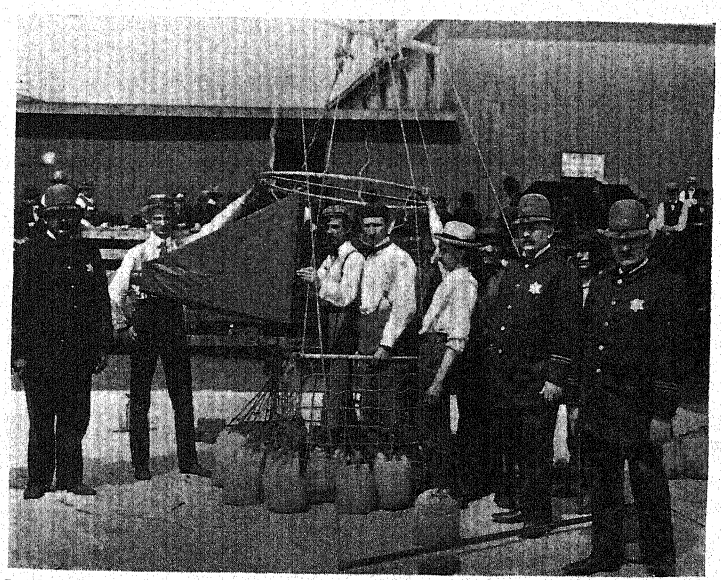
LAWRENCE AERIAL CAMERA. Suspended beneath kite lines, this was the smallest aerial camera which Lawrence built. At left is a close-up of the camera with a panoramic action and at right is a similar camera shown as it was suspended in mid-air. The spars and rigging helped to steady the camera. See article on *Lawrence*
Photos from H. H. Slawson

continued. It is still used when expense is a factor and when no airplane is available (see *Archeological Photography*, page 254). Reconnaissance photo work is still done from the captive balloon. And some of the most spectacular photographs ever taken from a high altitude were taken by Lt. Col. Stevens in his stratosphere balloon.

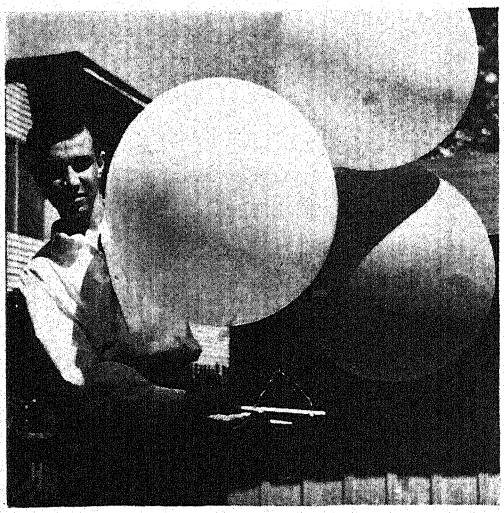
KITE PHOTOGRAPHY

The use of kites for obtaining aerial photographs developed as an outgrowth of the adaptation of kites to meteorological investigations. In England, E. D. Archibald, a meteorologist, is given credit for making the first successful photographs from kites in about 1882. Meanwhile, across the channel in France, A. Batut of Paris began experiments in kite photography in 1886. Batut later recorded his achievements in a textbook, *La Photographie aérienne par Cerfvolants*, published in 1890.

Archibald's system embodied use of several kites, attached tandem style to each other with the camera suspended below the farthermost kite on the line. Batut used only one lozenge-shaped kite to whose backbone the camera was attached by a triangular support. To release the shutter he provided a "slow match" or fuse which was lit before the kite



GEORGE R. LAWRENCE. Here is a close-up of equipment for balloon photography in 1901. Lawrence, wearing the skull cap, did pioneer work in aerial photography and his achievements are described in the article entitled *Lawrence*
Photo from H. H. Slawson



HOMEMADE BALLOON SET-UP. Omar Gonzales of San Antonio, Texas is shown with his hydrogen-filled balloons and the small camera used for taking aerial photos. The camera is usually held at 6 feet from the balloons, to eliminate as much movement as possible

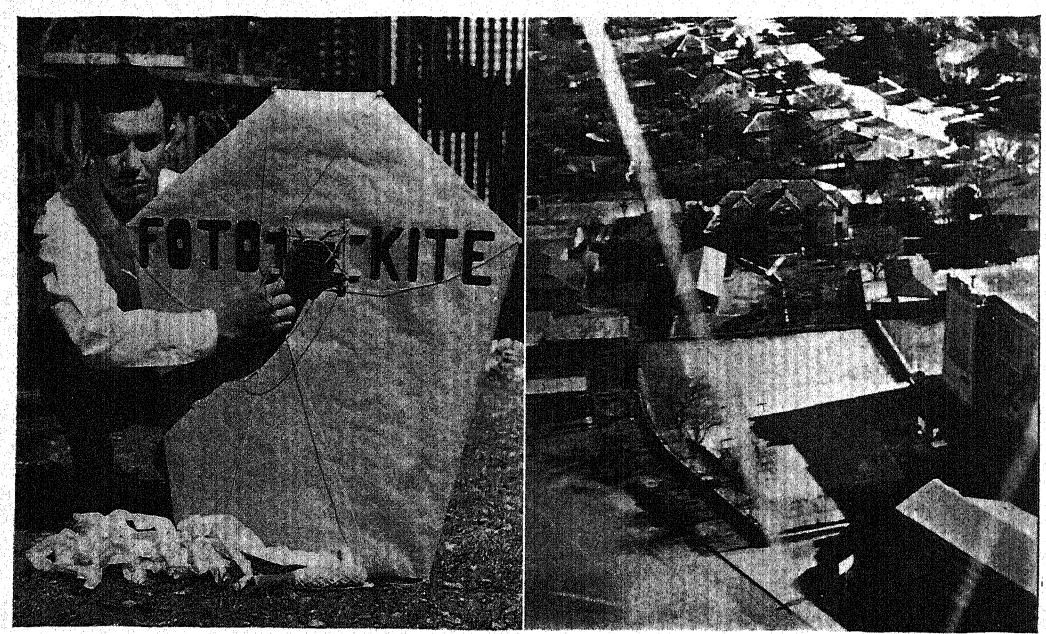
was raised and which eventually ignited a thread controlling the shutter. Simultaneously, also, release of a piece of paper indicated to the operator that the exposure was completed.

To determine the altitude at which the picture was taken, Batut's equipment included an aneroid barometer with a self-registering photographic apparatus. As the camera's shutter closed, the movement opened a tiny aperture through which the rays of the slow match printed on a strip of sensitized photographic paper the shadow of two needles from which the altitude could be figured.

Both Batut and Archibald made "map views" with the lens pointed straight downward. At Rheims in 1890 another photographer, Wenz, made the first horizontal perspective views from kites, although as the records state, "the slant was very great."

AMERICAN KITE PHOTOGRAPHERS

In the United States another meteorologist, William A. Eddy of Bayonne, N. J., made, on May 30, 1895, what he claimed was the first photograph from a kite ever taken in the western hemisphere. Eddy used a "Bullet" camera with a 3½ x 3½-inch film and employed a timed slow match to release a weight attached to the shutter. The camera was enclosed in a box attached to a revolving



MODERN PHOTO KITE. Omar Gonzales of San Antonio, Texas is shown with a homemade foto-kite at left and at right is a photo made of his neighbors' houses. The kite, except for special wires, is a normal one and operated in the normal way. The camera support is made of balsam wood. To shoot the picture either the timer method is used or the shutter is released by a string from the ground. The timer is a short piece of string that burns up to a rubber band that releases the shutter

table and its rear could be raised or lowered in a slot by a set screw, so that the lens could be directed at any slant to any desired compass point. Finding that the dropping weight caused a blurred picture, he added a light cord on which a steady pull could be exerted from the ground to steady the camera at the time of exposure. He also used a light wooden T-frame attached to the kite line and the camera to prevent side swing in more than one direction. With six to nine kites on his line, Eddy obtained pictures at heights up to 1,000 feet and claimed that it might be possible to raise the camera to 16,000 feet.

For best results, however, he recommended an altitude of not over 500 feet with a camera making pictures under four inches in size. Larger pictures, he argued, would require heavier cameras and involve danger of breaking the kite line. With his kites, he stated, he made as many as thirty-two aerial pictures in a day and occasionally made simultaneous snapshots with three cameras working together on his line. During the Spanish-American War, his system was used by the United States Army Signal Corps to supplement balloon photography in Puerto Rico.

The outstanding exponent of kite photography, however, was undoubtedly George R. Lawrence of Chicago, whose achievements brought him world-wide attention (see article on *Lawrence*). In 1902 Lawrence developed a kite system using as many as seventeen kites which lifted his cameras up to 2,000 feet. Pictures from 2 to 8 feet long were made by his seven different aerial cameras, which weighed from 400 to 1,000 pounds. This outfit he employed in aerial surveying work in the western states and on an African exploration expedition. One of the most famous of panoramic views—that of San Francisco after the fire—was taken by Lawrence from a complex arrangement of kites.

Kite photography, like balloon photography, still continues today—and is particularly used by people who cannot afford or cannot obtain the use of an airplane. Such use of kite photography has been mentioned in connection with exploration (see article on *Archeological Photography*, page 253).

KODACOLOR PHOTOGRAPHY

The Kodacolor color negative process, introduced by Eastman Kodak in January of 1942, is here described from the practical point of view. Exposure data for both daylight and artificial light are given, as well as hints on the handling and use of the film.

See Also Color Negatives With Kodacolor

KODACOLOR WAS MADE available in January, 1942*. It is a color process in which color negatives are made on roll film by exposing the special rolls in ordinary cameras. The films are processed by the Eastman Kodak Company and are printed by them to give color prints on paper. Since the process was first put out, much has been learned which is of value as a guide to making the best of the process. This article gives a few hints based on films which have been turned in to be developed and printed by the Eastman Kodak Company.

Kodacolor Film is specially made to be used outdoors in sunlight. It gives its best results under these conditions. The use of front lighting is recommended. The color differences in the subject should be relied on for giving the necessary contrast in the picture. It is important to exercise care in exposing the film, because errors of more than one stop tend to falsify the colors. There is more latitude in the exposure of Kodacolor Film than in the case of Kodachrome, but it should always be borne in mind that color films have less exposure latitude than black and white films.

KODACOLOR EXPOSURE

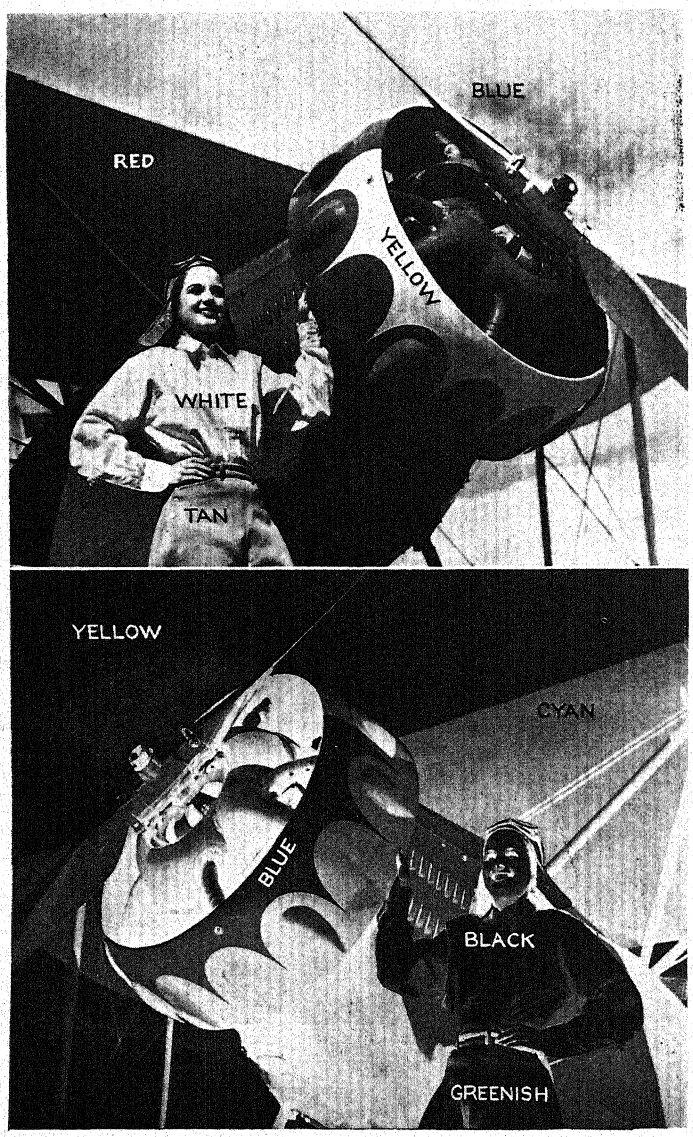
Kodacolor Film is suitable for use in all types of roll film cameras. If the lighting conditions are poor, good exposures cannot be obtained with cameras which have very slow lenses. However, with lenses of f/6.3, fairly satisfactory results may be expected. It is to be remembered, however, that good color pictures cannot in general be expected by any process unless the light is bright—preferably full sunlight.

* Kodacolor was the name of a former Eastman lenticular movie film process, based on the additive system. This obsolete Kodacolor film was introduced for 16mm use in 1928 but was discontinued after the perfection of Kodachrome movie film in 1935. For a fuller description, see page 827.

Within two hours after sunrise or two hours before sunset the light tends to be orange in color and Kodacolor pictures of people should not be made at these times, as good color rendering cannot be expected. For some subjects, naturally, the photographer may desire to utilize the effects obtained in this warm colored light—for instance in architectural and scenic subjects—but at least twice the normal exposure should be given.

In making portraits outdoors, the subject should be arranged so that the face is underilluminated while the rest of the subject is dark. This may result in contrasts which give a "burnt-out" effect on the face. Hazy sun conditions give pleasing results. On the other hand, cloudy bright conditions will tend to give bluish prints, while exposures made in the open shade with a clear blue sky will give prints of a pronounced blue color and of low contrast. If it is necessary to make pictures under such conditions, the lens opening should be about three times larger than for full sunlight.

The exposure meter settings for daylight and Kodacolor Film are Weston 20, General Electric 32. The table at top of page 2183 provides a good guide to exposure.



Colors in a Kodacolor print (above) reproduce those in the original subject. The Kodacolor negative (below) reverses both tone and color values and the lettering indicates the actual colors of the negative—complementary to those of the print

WITH ARTIFICIAL LIGHT

Kodacolor film is made for sunlight exposure, and the best results cannot be expected with artificial light unless proper care is taken. If it is desired to make pictures indoors by artificial light, regular or daylight photoflood lamps or clear bulb photoflash lamps, or their Wabash equivalents *should not be used* as the pictures will be orange in color. The best results are given by the blue No. 21B Photoflash lamps or other equivalents having exactly the same color blue bulb.

The color quality of the prints obtained will depend on the exposure, the individual lamp, the reflector, and on the color of the surrounding walls and draperies which may reflect their color onto the subject. In making Kodacolor pictures with the blue photoflash lamps, diffusing reflectors

DAYLIGHT EXPOSURES FOR KODACOLOR

These values are for *summer conditions*. For *winter scenes* without snow, one lens opening larger should be used in all cases.

Shutter set for 1/50 second

Subject conditions	*Bright summer sun* Front or side lighting	*Hazy sun* Subject in open	*Cloudy bright* Subject in open
Light colored	Between f/11 and f/16	Between f/8 and f/11	f/5.6
Average subjects	f/11	f/8	f/4.5
Dark colored	Between 5/8 and f/11	f/6.3	f/4

Note: With cameras having lenses slower than f/6.3, snapshots should be made only under conditions of bright summer sun, and with the largest lens opening.

must be used, and the light must not be concentrated on the faces of the subjects. Before giving artificial light data, it should be repeated that *this film is intended for daylight.*

Wabash Data. Daylight Blue Superflash can be employed to reproduce, for indoor or outdoor use, the outdoor sunshine lighting conditions that are ideal for Kodacolor. This blue bulb has the higher 6000° Kelvin color temperature that closely approximates the Kelvin temperature of bright summer sunlight.

ONE BULB—DAYLIGHT BLUE SUPERFLASH

For indoor use with Daylight Blue Superflash only—one bulb—at 1/25 second, in a medium-sized room with average light-colored walls. For dark walls, use one full lens stop larger. Distances are figures from lamp to subject.

Bulb Size	6 ft.	9 ft.	12 ft.	16 ft.
No. 0B	f/11	f/8	f/5.6	—
No. 40B	f/16	f/11	f/8	f/5.6
No. 2B	f/22	f/16	f/11	f/8
No. 3B*	—	f/22	f/16	f/11

* When using one bulb mounted at the camera, it is not recommended that the No. 3B be used at distances closer than 9 feet.

TWO BULBS—DAYLIGHT BLUE SUPERFLASH

For indoor use with two Daylight Blue Superflash bulbs, both the same distance from the subject, but one mounted at the camera and the other mounted on a side extension at a 45 degree angle to the camera. Shutter speed 1/25 second. Tests made in a medium-sized room with average light-colored walls. For dark walls, use one full lens stop larger. Distances are figured from lamp to subject.

Bulb Size	6 ft.	9 ft.	12 ft.	16 ft.	20 ft.
Two No. 0B	f/14	f/9.5	f/6.3	f/5	—
Two No. 40B	f/19	f/14	f/9.5	f/6.3	f/5
Two No. 2B	—	f/19	f/14	f/9.5	f/6.3
Two No. 3B	—	—	f/19	f/14	f/9.5

Where additional lighting is desired, especially for general background illumination, Daylight Blue Superfloods will aid materially in securing good results when only one flashbulb is used. Ordinary incandescent lamps and regular photographic flood bulbs are *not* recommended for use since their Kelvin temperature is too low and result in imperfect color reproduction. The Daylight Blue Superflood may be used, as this has the higher Kelvin temperature required for use with color films such as Kodacolor.

General Electric Data. When Kodacolor film was introduced, Eastman Kodak recommended the 21B Photoflash lamp for pictures by artificial light and published guide numbers for this lamp and the Kodacolor film. No exposure data for the 5B lamp have been published heretofore. Since both lamps are coated with lacquer containing the same blue dye and both have the same color temperature, they should give the same quality of color reproduction with Kodacolor film. Tests made in the Nela Park laboratories of the General Electric Company have indicated that either lamp may be used. Successful use of these lamps with this film depends upon proper illumination of the sub-

ject and accuracy of exposure, just as in the case of the Kodachrome film. Because of the fact that the photographic effectiveness of the lamps is determined not only by their light output but also by the efficiency of the reflector used with the lamp and by the amount of light reflected from the surroundings onto the subject, the following exposure table gives a range in guide numbers. The latitude of the film is such that an exposure in the indicated range should give a passable negative. The individual photographer should determine which guide number gives the *best* results with his equipment.

MAZDA PHOTOFLASH LAMPS WITH KODACOLOR

(Nos. 5B and 21B)

Lamp	*Shutter Setting*	*Guide Numbers**
5B	Time, Bulb, 1/25, 1/50.....	45–60
	1/100.....	35–50
	1/200, 1/250.....	28–40
21B	Time, Bulb, 1/25, 1/50.....	55–70
	1/100.....	45–55
	1/200, 1/250.....	35–45

*For use of guide numbers, see page 1795.

HANDLING THE FILM

There are a few points which it is important to bear in mind in loading, unloading, and winding the film in the camera. When loading or unloading, the roll of film must be held very firmly, otherwise it may unroll somewhat and become fogged.

Extra film which is essential for control in developing is supplied on the end of each roll. It is very important that only the number of exposures specified for a particular camera should be made on a roll. If the extra area at the end of the film is exposed in the camera or fogged, it will be impossible for the operators to determine the correct color balance for printing. If prints are desired from such negatives, the best judgment of a skilled operator will be used in obtaining color balance, but the color reproduction may be unsatisfactory. Film which is partly exposed and then left in the camera for a long period may produce unsatisfactory results, especially if it is subjected to high temperatures.

When prints are made from Kodacolor negatives at the Eastman processing station, some masking will occur at the edges and it is therefore important that the chief subjects should be kept in the center of the picture. Bear in mind also that it is not possible to print portions of negatives, nor to make enlargements greater than the standard print sizes. Within certain limitations, however, Kodacolor prints may be cropped during enlargement. The photographer who wants unsightly backgrounds or out-of-focus areas taken from the picture, indicates the cropping with scotch tape placed on the base or glossy side of the film.

LANDSCAPE PHOTOGRAPHY

Ira W. Martin

Landscape Photographer; Staff Photographer, Frick Collection, New York

Here is a photographic field which can be approached from many angles—from the superpictorial to the ultra-documentary. Every photographer can and does take landscape pictures and there is no reason why these should not be interesting. The pictorial landscape and compositional forms are discussed—also the historical and documentary approaches. And there is an interesting warning about the human figure in the landscape photograph.

See Also Composition, Desert Photography, Farm Photography, Mountain Photography, Pictorial Photography

PROBABLY THE TWO MOST NATURAL things to be used as the subject of a picture are fellow human beings and the beautiful land upon which we live. From the very first attempts at picture making to the present time, these two subjects have been the favorites. In early times, not so long hence, almost everybody had to spend the greater part of their lives out-of-doors. They never seemed to tire of the beauties of the land in its changing moods, despite the fact that they saw it every day. The whole outdoors is a great store of beauty and interest. If these wonders of the land never fail to stir the feelings of those who spend their daily lives among them, is it any wonder they are most thrilling to those who seldom have a chance to see them?

So let us see how to put these outdoor moods and beauties into pictures in such a way that they will not only record the bare facts but remain a constant source of pleasure to look at, as well.

FUNDAMENTAL PRINCIPLES

First of all, one should have a real love of and interest in the subject of any contem-

plated picture. A landscape will be more complete and satisfying if the finished picture not only presents some pleasing phase of landscape but also has some significance or story to convey. A beautiful landscape without something of the sort is like a splendid stage setting without the play. So many things take place at different times of the year in outdoor life that it is not difficult to think up something which will suggest a reason for making the picture besides a scene in nature, even if something is not actually happening at the time. Neither is it enough to make a splendid example of composition or design. In short, a successful landscape should have good composition, design, or pattern, a well-balanced and well-executed tone scheme, if possible a pleasing mood or phase of the outdoors, and a story or significance—either literal, suggested, or abstract.

As a foundation for any new pursuit, it is well to become acquainted with what has been done in the past and what is being done at present. We shall not make a special study of this now, but will refer to past examples as we go along.

EQUIPMENT

To get right down to work, let us talk over the equipment we need.

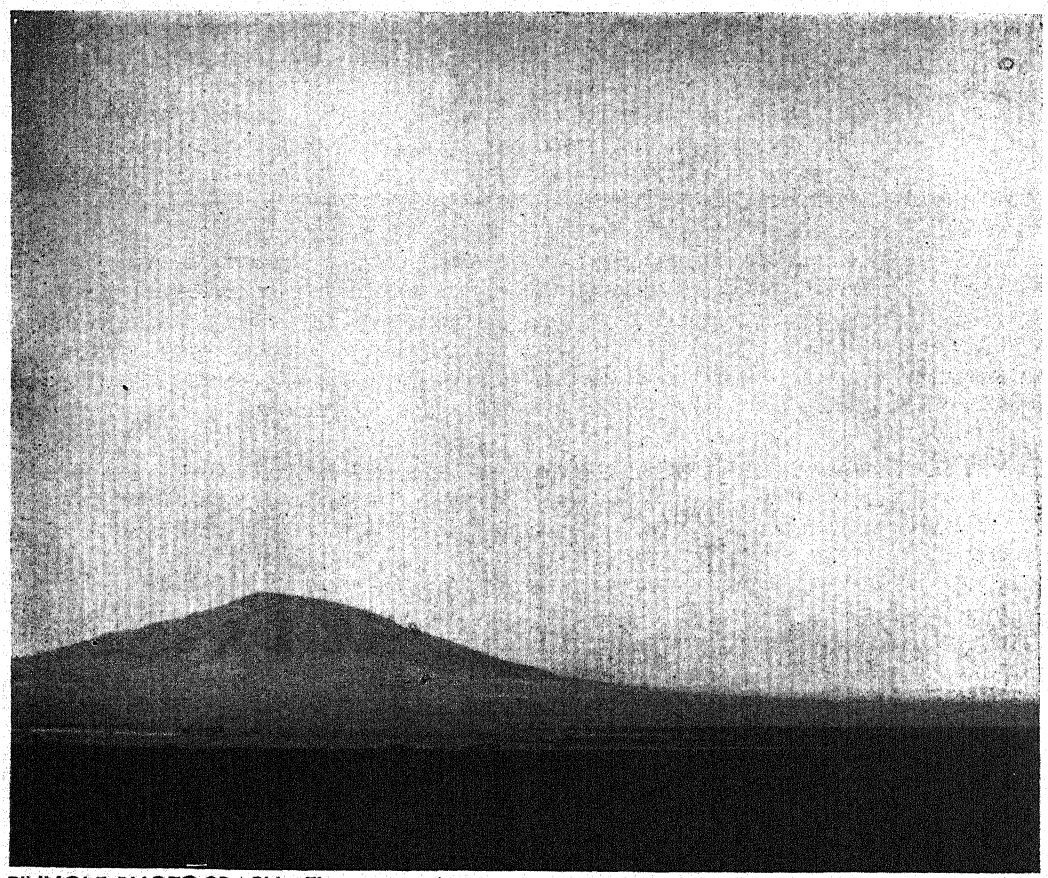
Tripod. If we are going about this thing in a serious way we should have a tripod. The particular reason for this is that the composition of a landscape is almost entirely made by changing the viewpoint—the particular point in space which the lens occupies. When this is found, one does not care to lose it if it becomes necessary to move an object in the foreground or for any reason leave the camera. If one is interested in the detailed type of picture and finds it necessary to stop down to f/64, the tripod is very necessary because the slightest movement would destroy the detail gained by stopping down.

Camera. Next comes the camera. It is a fact that almost any camera can be used, but some cameras have limitations and advantages are to be found in others. If one is to tramp the fields, the smaller cameras have obvious advantages. But once the photographer has found his spot they have decided disadvantages when it comes to making the picture. It lends itself to fragments or details of landscape but is almost inadaptable to the open or broad expanse type of landscape. If the very detailed type of picture is desired, the very small camera defeats itself from the start but is quite suitable for the tonal mass type of picture where sharp detail does not matter.

For the really serious worker nothing can equal a view camera of 4 x 5 or larger. One of the shorter focal length reflex cameras, from 2¼ x 2¼ to 4 x 5 depending on the amount of detail desired, will be found to be exceptionally good because one sees the picture right side up, in a fairly good size and completely isolated from the rest of the world. This makes it possible really to get the "feel" of the thing as a whole—and in good pictures it is the "feel" that counts, even more than studied planning and analysis, which are apt to be apparent.

Lens. The lens is only relatively important. That is to say, a good landscape can be made with an old rapid rectilinear lens or even without a lens at all, as was the case with Laura Gilpin's pinhole picture.

Of course a good lens has a crispness and brilliance which is noticeable in the hands of a good photographer. Some years past it was the practice of both photographers and painters to give impressionistic atmospheric effects rather than solid realities. This brought about the use of the soft focus lens which in reality was a lens or magnifying glass with but slight correction, if any. The result was a scattering of blue and violet light when not stopped down. "The Mill Pond" is an example of soft focus lens work. The use of this type of lens is being revived in the Balkan countries where they have such feeling for freshness, morning sunshine, mist, and the smiles of children. One must not confuse this type of picture with those taken with a sharp lens covered with a diffusion disc or gauze or diffused during the enlarging or printing. All of these latter methods of attempting a mood or other effects lack the sparkle of light which is caused by the lens itself. Of course, all of this is worthless trash to the realist who wants the hard facts with all their revealing textures and quality as produced by a good sharp lens. If the focal length of the lens is that of the distance be-



PINHOLE PHOTOGRAPH. This picture of a majestic and distant mountain was taken with a pinhole camera and demonstrates the fact that the first necessity is, not equipment, but a photogenic landscape and the eye to see it
Photo, Laura Gilpin

tween opposite corners of the picture, it will be found to give satisfactory results in most cases.

Accessories. In addition to the tripod, camera, and lens one should have a good lens shade, a light yellow filter, a dark yellow one, and a red filter for dramatic skies. The lens shade or hood is important. It should be more than just a sunshade which extends an inch or so in front of the lens. It should be a real hood which extends in front of the lens to a distance equal to one half the distance from the film to the lens, rectangular in shape, and the front as small as possible, without cutting into the image. The camera should be covered with the focusing cloth during the exposure to guard against light leaks which often show up when working in direct sunlight. This is particularly true when working with old bellows cameras.

The choice of film emulsion can be decided according to the type of finished picture desired. If the picture is to show a landscape in a foggy, atmospheric, high key mood, the result will be achieved with least difficulty on an orthochromatic film. On the other hand, if a strong, vigorous, realistic, definite image is wanted, it is better to use a panchromatic film which will give darker shadows and brighter highlights. It must be kept in mind that all filters require much greater exposure when used with an ortho film than with a pan.

Once the equipment is established, it can be forgotten—it is only a means to an end. The particular way this equipment is to be used will be determined by the photographer's attitude toward his subject, which will also determine his selection of material for his pictures.

THE PICTORIAL LANDSCAPE

It is not the purpose of this article to advocate any particular attitude or approach to this subject of making a picture of a landscape, but rather to take up the different approaches one by one, starting with the older, established conception of a beautiful landscape for beauty's sake and finishing with the present-day document. In the end the photographer will have a preference and it is that preference which determines his choice.

The very earliest landscapes in painting were usually made as a vista seen through a window or as a background for a portrait and usually had a relationship to the subject of the painting in which it appeared. The early Dutch and Flemish made paintings of their people at work and at play. In these pictures we find some splendid examples of composition as in the works of Peter Breughel and his contemporaries. The chief interest of the painter seemed to be the activities of his people rather than a beautiful picture or a studied plan of composition. Later on, Hobbema, a Dutch painter, painted landscapes which were inspired by an artist's love for a beautifully composed picture. About the same time Cuyp became interested in the effect of light and air, especially the golden glow of sunset. Following in this direction the Englishman Turner became a virtual impressionist, that is to say, he painted the impression or appearance of objects as seen through sunlit atmosphere or windblown mist, etc. They were paintings of actual scenes but the atmospheric conditions were of more interest to Turner than the particular locality of scene. Monet and his following, including soft-focus photographers of twenty five years ago, carried this interest in impressionistic effects to a point where there was almost no recognition of the objects in the scene.

As a sort of middle ground of this gamut of landscape painting let us take the British school of Constable, Gainsborough, and their contemporaries and followers, which includes most British photographic pictorialists of today. When the Britisher sets forth with



THE MILL POND. The soft focus lens was used to achieve a dreamlike effect and the feeling of morning mist. Such soft pictures represent a long-standing pictorial school of landscape photography
Photo, Ira W. Martin

his camera to make pictures of his beloved countryside, he does so with the spirit of a man who loves nature, the whole outdoors with its sunshine, mists, trees, fields, hills, and valleys. He is anxious to get all of this



HOBBEMA LANDSCAPE. Much can be learned from a study of landscape paintings. This Dutch painter of the seventeenth century studied composition carefully and could well combine atmosphere and the feeling of human activity
From the Frick Art Reference Library, New York

into his picture. He has also developed an appreciation of composition and all else that helps make a beautiful picture. He tries to make a picture which will capture these beauties and which will present them to others.

COMPOSITIONAL FORMS IN LANDSCAPE

If the pictorialist comes to a long road lined on either side with tall poplars, he thinks of a composition which will express stately grandeur and dignity. The symmetrical arrangement in a vertical space comes to mind. If there is a stately building at the end of the drive, one with tall columns, it will still further add to the dignity of the picture. In this arrangement it is well to keep the horizon line near the bottom of the picture by placing the camera near the ground and raising the front of the camera to give height to the trees. If a view camera is used, the lensboard can be raised or the camera can be pointed up, correcting the distortion by using the swing back. If the front and back of the camera are fixed, the distortion will have to be corrected during enlargement.

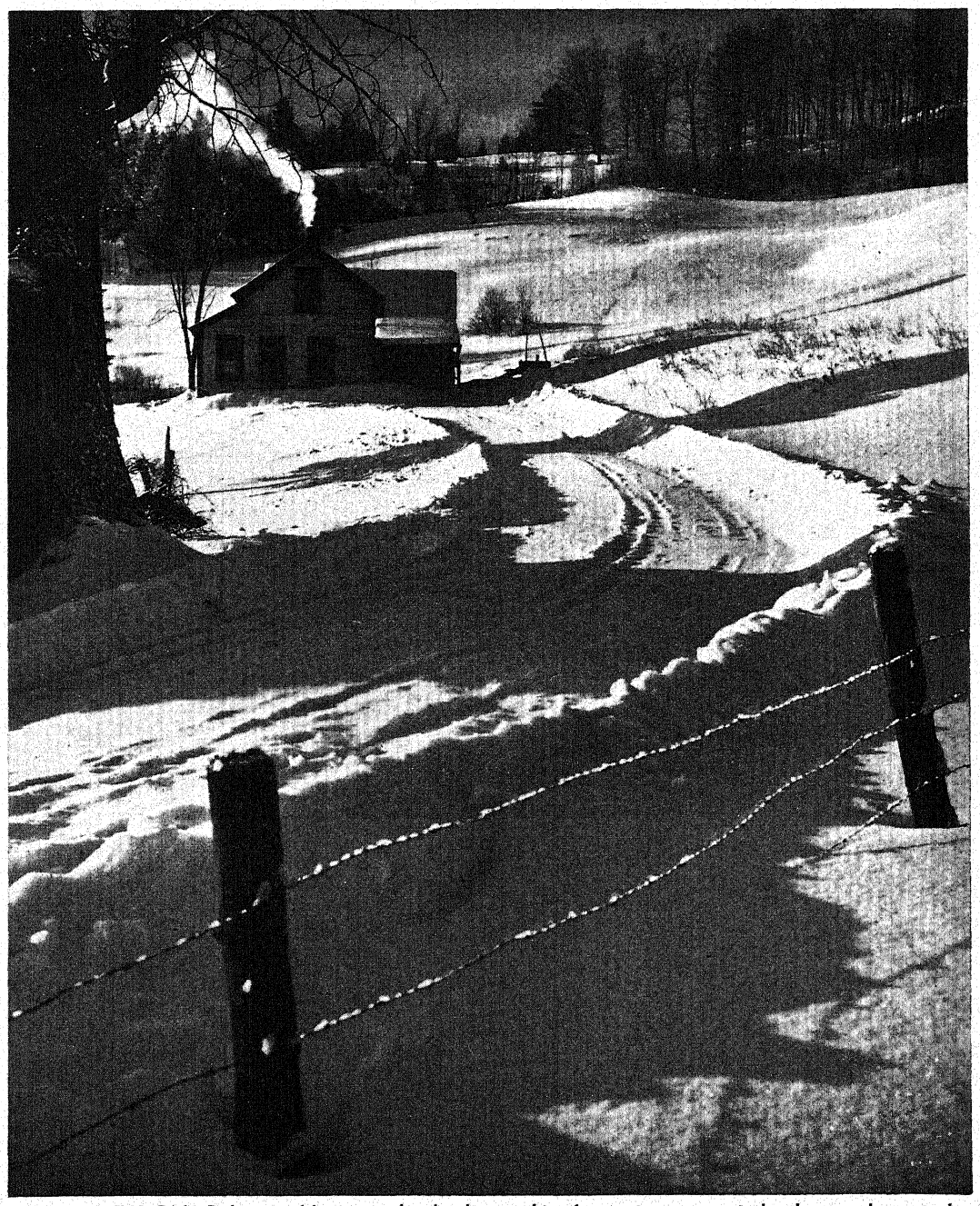
The Scotch Plaid Test. Another plan of composition which is used in the more simple landscapes is the vertical and horizontal scheme. To be successful and pleasing to the spectator, this type of picture must have well planned spaces and relationship of spaces to each other. As an analysis of this form of composition, the "Scotch plaid" test is sometimes made. It will help one understand this plan of composition if one tries it out on some pictures. In the first place this plan of composition is two-dimensional, with objects spaced across the picture and up and down. As a check, place a piece of tissue paper or other thin paper over the picture and with a soft pencil draw vertical lines through each tree or other object. Make a heavy line for large trees and small lines for small one, etc. Then draw a horizontal line along the horizon, across the base of trees, across the tops of trees and clumps of trees, etc. Then draw a line around the border of the picture, remove the tissue, and study the vertical and horizontal pattern or plaid. To learn what a pleasing plaid really is and what makes it pleasing, one should study the spacing, width, and weight of lines in a good Scotch plaid. When this is understood and feeling for good spacing and relationship of spaces is developed, the vertical and horizontal line tracing from a picture will soon convince one that it is good or should be changed. After practice, one will feel these spacings while arranging the picture on the groundglass.

The Diagonal Plan. The most usual arrangement in landscape pictures is the diagonal plan in which a greater part of all



COROT LANDSCAPE. Well-known landscape artists like the Frenchman, Corot, have influenced landscape photography greatly—particularly the pictorial school. Compare this of The Boatman of Montefontaine with "The Mill Pond" on page 2187 and see that both have similar moods and compositions
From the Frick Collection, New York

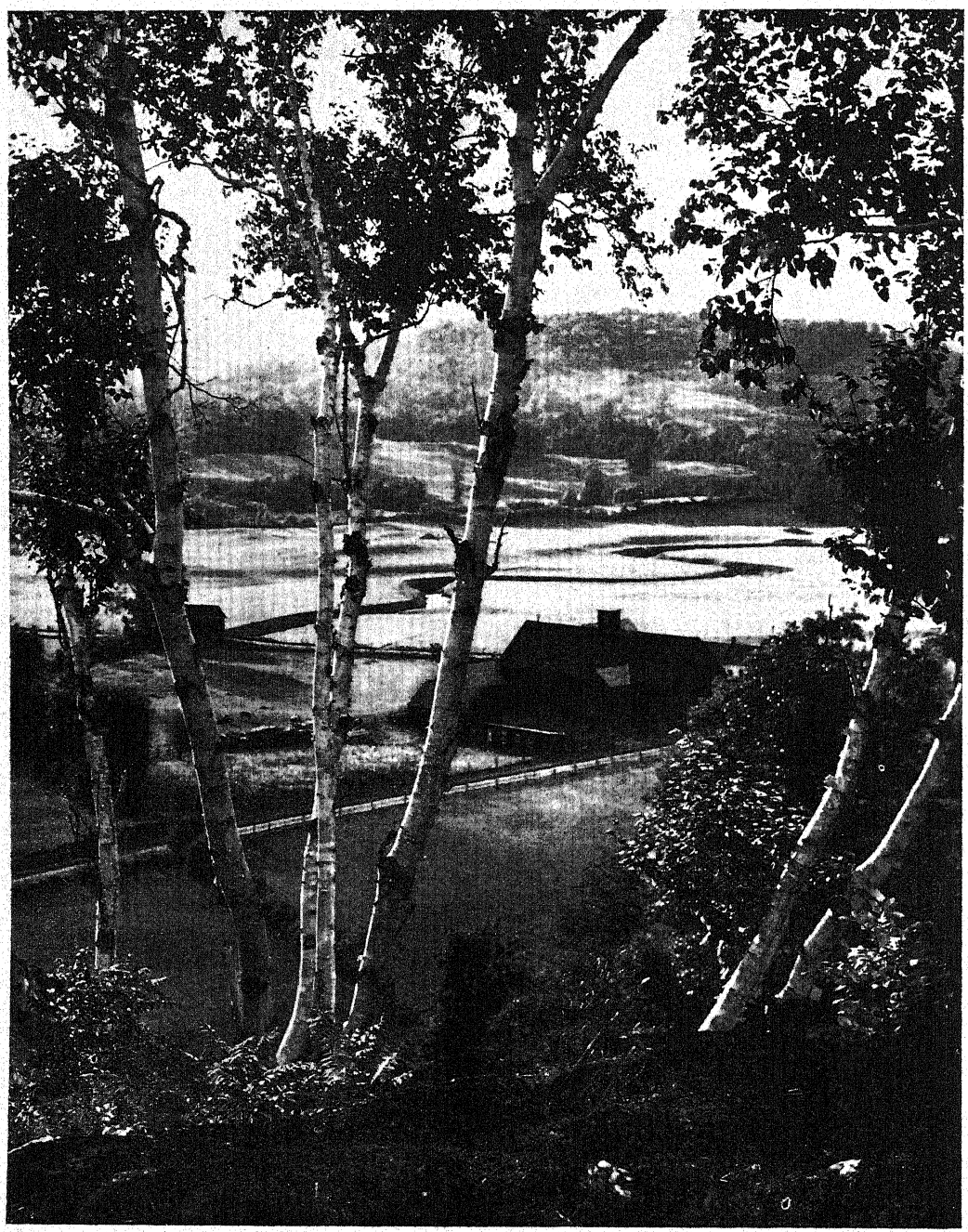
the dark parts of the picture are in the lower diagonal half and nearly all the light areas are in the upper diagonal half. Try this test on the next pictures or reproductions you see. Hold a book or paper over half the picture, dividing it diagonally from one lower corner to the opposite upper corner in the direction which leaves most of the sky on one side. In a great many pictures it will be found that nearly all the sky is in one half



BREAKFAST IS ON. Relation of foreground to background is of great importance in landscape photography. The foreground has been given emphasis here, and it is the curve of the plowed road, the nearby fence, and the soft rolls of the hillside which characterize the landscape
Photo, Gustav Anderson

and nearly all the ground and trees are in the other half.

This has long been a favorite plan of landscape painters. Rembrandt, Constable, Gainsborough, Moreland, and Corot were great exponents of the diagonal arrangement and there are many good reasons for its popularity. First: the massing of the heavy material saves the picture from having a scattered, over-all disorderly appearance. Sec-



VERMONT. The high view will often make for interesting patterns in a landscape. With a good deal of careful study, composing of a high degree can be done in a landscape, as this view will prove
Photo, Ralph E. Day

ond: to have a heavy mass at one side of the picture and attached to or part of the ground area, the picture takes on strength and solidity. Third: this solidity forms a splendid contrast to the more delicate parts of the picture. Fourth: having a strong foreground at one side of the picture with smaller, more delicate detail in the distance is one of the most effective means of obtaining distance, depth, or third dimension in a picture. And, finally, it affords a partial vista effect which is usually pleasing.

CONTROLLING COMPOSITION

Of course the painter can change the size and position of objects at will and it is often argued that the photographer is compelled to take things as he finds them. This is only partly true, because in most cases the photographer can change the size and composition of objects like trees by changing his position. Let us go into the country where we find a little old house with some trees around it. Off to one side near the road is a little barn with a tree near it. Now it stands to reason that if we start walking around the house away from the barn, the space between the house and barn will become less and finally the barn will be behind the house and out of sight. On the other hand, if we walk closer to the house and around the side nearest the barn, the space between them grows greater until the barn passes out the side of the picture as we begin to pass between the two. Their sizes may be changed by moving nearer or farther away. Their relation to the foreground can be changed by raising or lowering the camera. When the camera is placed on the ground or even below a rise of ground, all objects stand on or below the horizon line.

This practice should be followed if a feeling of great height is desirable. Whereas, an unusually high point of view, as from an elevation, gives an opportunity for a flat, over-all pattern, possibly of fields and fences. It will be found that by study and practice, a great deal can be done in the way of composing any outdoor scene. In addition to the above methods of changing the spacing and position of different objects, the selection of the best time of day will do much toward good distribution of the light and dark areas.

THE HUMAN ELEMENT

The composition is an important part of this pictorial type of landscape, but of equal importance is the presence of some activity of the everyday life of the people who inhabit the country. If it is a road scene, some characteristic travelers or wayfarers will add a point of interest. If it is in the fields, there is always something going on like ploughing, planting, or harvesting, etc. These points of interest should be arranged in the particular part of the picture which feels best in the composition. *There should be only one point of principal interest in a picture.* There can be a subordinate point or bit of activity, but it should be related in some way to the prime interest, certainly not foreign to it. These activities should be incidental to the scene. If they are made to predominate the picture, it becomes a genre rather than a landscape.

The introduction of human figures should be done with thought and deliberation. Accidents do happen but not often enough to rely on and the introduction of a figure or figures will make or break the picture, depending upon the placing, posing, or attitude of the figures.

The "don'ts" in this case are so definite that they will be taken care of first. For instance, don't let the figure dominate the picture. If the person is of greatest interest, proceed with a good picture of the person and then, if you like, use the person as an accessory to the landscape. This recalls a page of cartoons which appeared years ago in the old *Life* magazine depicting a series of "snaps" of points of interest taken by a bridegroom on his honeymoon. It is needless to say the bride was of greatest interest to the photographer and appeared in front of and larger than the Capital of the United States, Niagara Falls, etc.

The next in importance is, *don't let the figure in the landscape face the camera or point with his arm or hand.* Either of these attitudes detract from the landscape rather than improve it and it must be remembered that the standing of an artist is arrived at as much by the undesirable things he leaves in his pictures as by the good things he puts in them. Leave nothing in your picture that will rate you down.



DEVON COAST. If human figures are to be included in a landscape, they should be properly subordinated and they should have a reason for being. This English farm scene is immeasurably improved by inclusion of people—especially the man and three horses at the center
Photo, J. Dixon-Scott

Now for the advantages of figures in the landscape. In the first place, it is natural for people to be interested in people and what they are doing. This makes the human figure the best kind of material for the point of interest in the landscape, or a place for the eye to come to rest. If possible the figures should contribute to the spirit and mood of the picture like driving the cows to pasture in a landscape of pastureland or a boy and dog going down the road which leads to a bridge or stream. In many cases the figure establishes a scale of relative size to scenic wonders such as in pictures of great trees or mountain scenes.

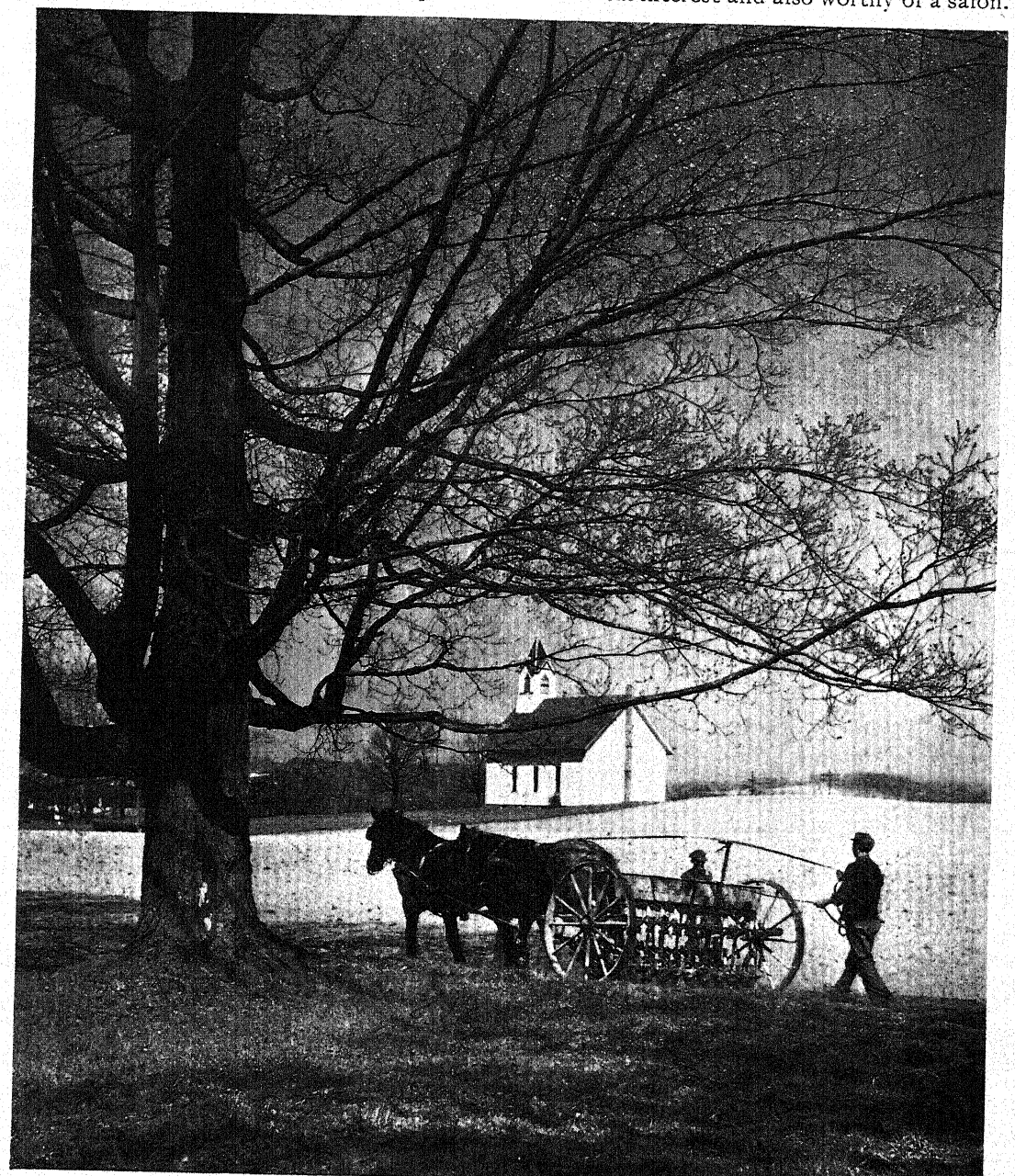
The exact placing of the figure is more a thing of feeling than rule, although it can be said that they should, as a rule, lead into the picture either by direction or posture. The most desirable place is seldom found in dead center (because it becomes static) but rather to one side of center and usually about one third of the width from one side. This is determined by the feel of balance in the picture and to the trained eye there is but one position for the figures and there is no alternate.

A good exercise in getting the feel of placing figures is to take magazine reproductions of landscapes by Corot, Constable, Rembrandt, and other recognized masters, cut the figures out, and then move them around to see how they feel in other places and see if they don't feel better where the master put them.

HISTORICAL APPROACH

Another pursuit or approach to the landscape is the historical. Let us say that a photographer is interested in the development of this country. He has become a student of this subject and wants to have photographic records of the coast and landing place at Plymouth, or perhaps the land over which King Philip's War was fought a hundred years before the Revolution. The many historical landscapes of the Revolution, of Roanoke Island, or Williamsburg, of the great West will all make good subjects.

Now in this type of picture it is obvious that the subject matter is more important than the making of a pleasing picture just to look at for its own sake. Still, it is not necessary to make them stark, barren realities, for they can just as well appear as pleasant scenes having an atmospheric mood and possibly some characteristic bit of present-day life as well. And photographs found in such magazines as the *National Geographic* will prove that such landscapes may be of historical interest and also worthy of a salon.

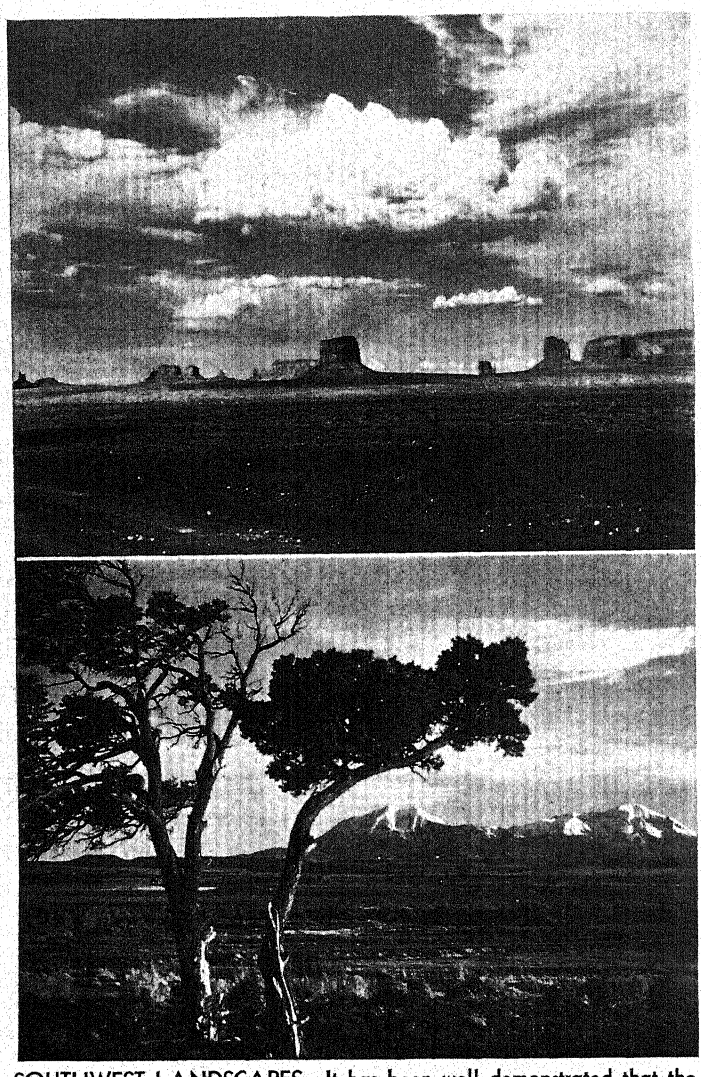


MICHIGAN FARM. It is hard to tell just where landscape photography begins and ends, just what can be included as legitimate landscape subject matter. Here is surely a landscape, for the tree, church, and figures have all been subordinated to make a complete "atmosphere" photograph
Photo, Philip Palmer

STRAIGHT APPROACH

A third approach is one which we may call the "straight" approach. This type of picture can best be understood by a study of the modern photographs made in the Sierra Nevada Mountain country by such photographers as Edward Weston. Theirs is a job to make an artistic photographic record of this country. The uppermost thing is the mountains or desert as they are in all their reality. The landscape is the whole picture—and without superficialities. To do a good job photographing a subject of this kind, one must have a love and understanding of the earth as it was created and it is this love and understanding which qualifies Weston for the job he does so well.*

Farm Security Administration. There is still another way of picturing a landscape and this might be called the documentary approach. This is the taking of a landscape which has a sociological significance. The pictures which first come to mind to illustrate this type of landscape are those made by the Farm Security Administration. To be brief, these photographs are intended to show life and environment—and the landscape is a potent means of illustrating both, especially the latter. They may depict in stark reality the plight of a dust bowl farmer or the prosperity of a Vermont sugar farm. In any event, to show the condition of the soil and of the homes is the real purpose of the documentary landscape.

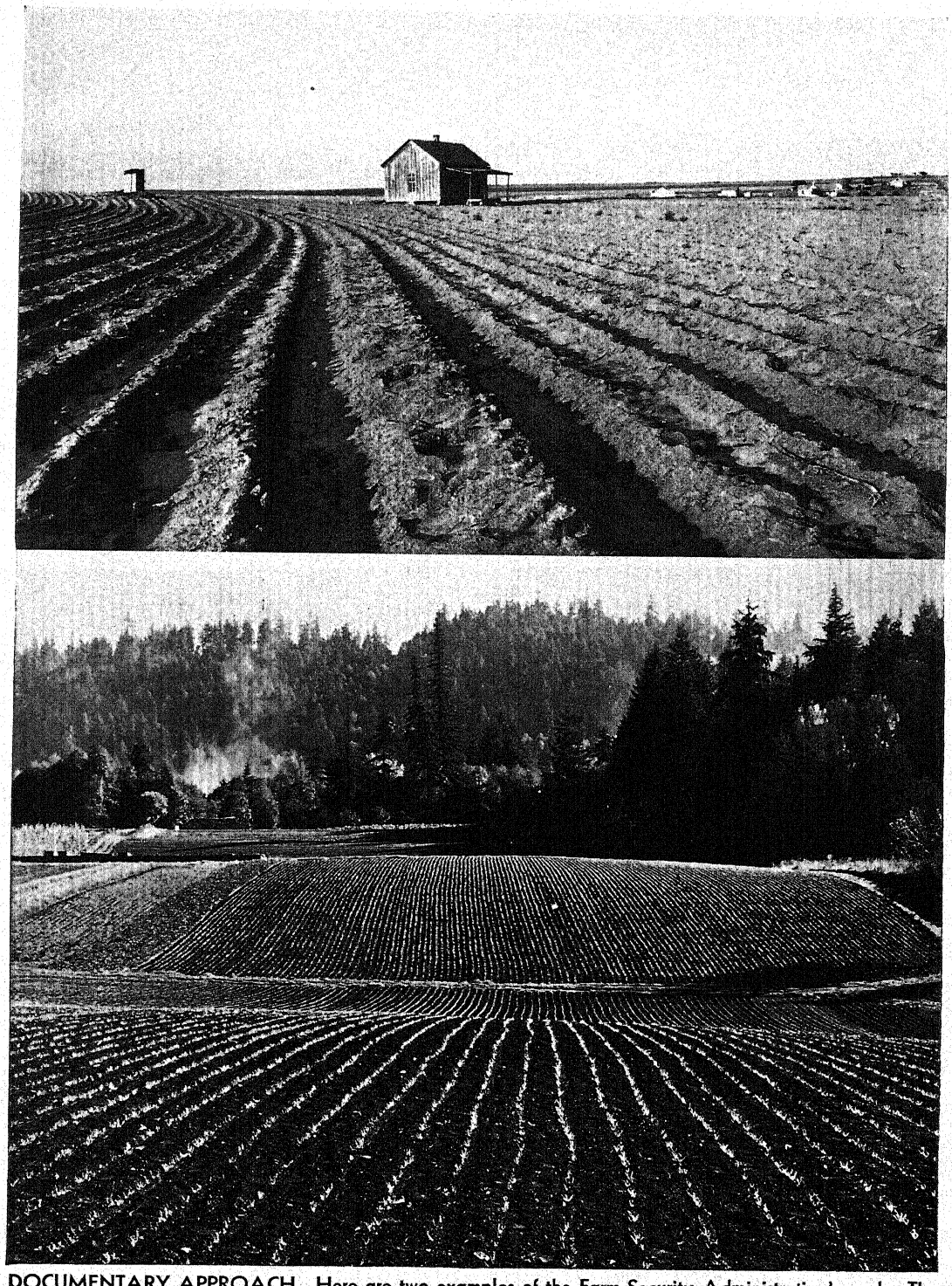


SOUTHWEST LANDSCAPES. It has been well demonstrated that the landscapes of the Southwest and California lend themselves well to the straight approach—that great depth of field and an "honest" lens can do wonders. Here are two examples of the western open country as seen by two photographers who live there. With such photography, lighting and point of view are all-important
Photos, Esther Henderson (above) and Rolf Tietgens (below)

ABSTRACT SIGNIFICANCE

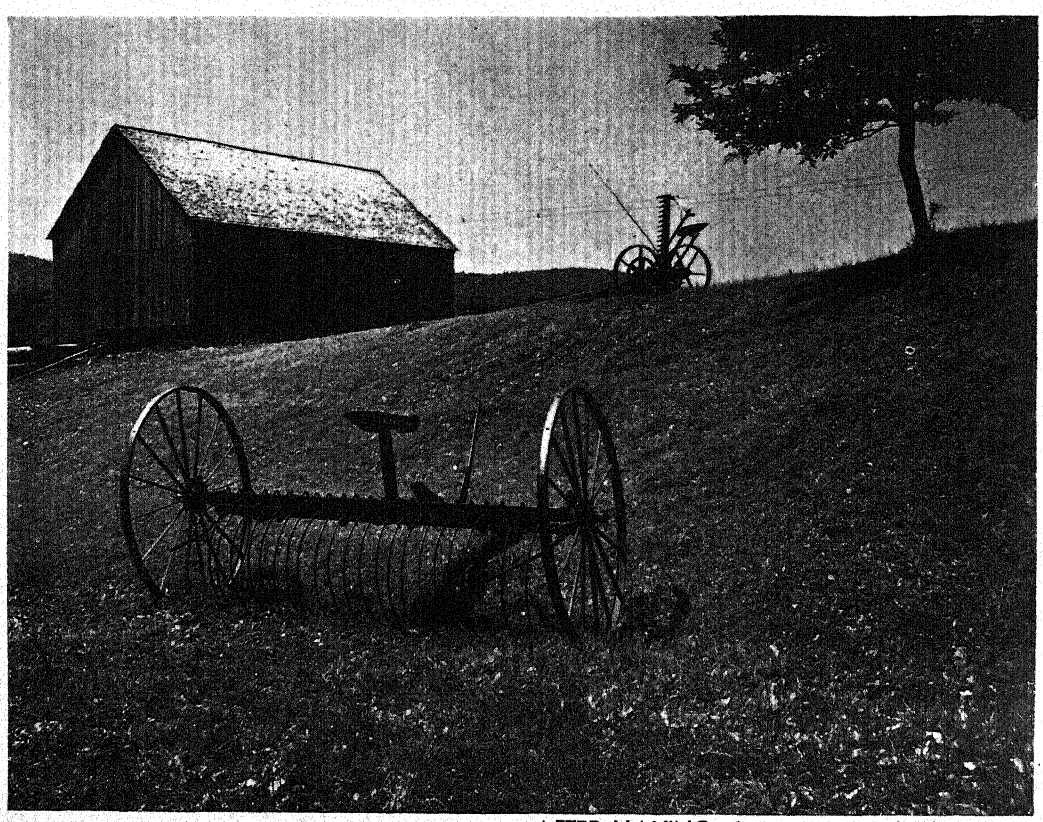
However, the splendid technical excellence which distinguishes the best of the documentary landscapes could well be employed in making landscapes which have abstract significance. It need not be built upon any accepted plan of composition. It need not have any of the romantic, rustic, picturesque, sweet beauties of nature to be found in full bloom on the calendar of your neighborhood grocer. It need not tell a literal story or have a social cause to fight for. But it seems to

* Many of those pictures are beautifully reproduced in his book, *California and the West.*

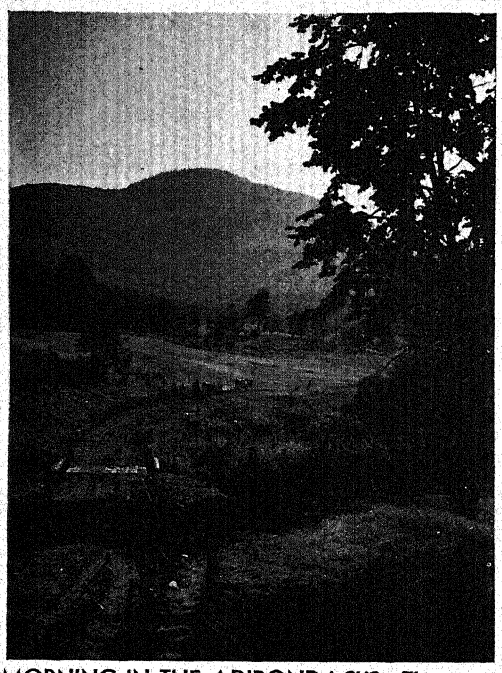


DOCUMENTARY APPROACH. Here are two examples of the Farm Security Administration's work. The purpose of these two photographs is to show conditions of the soil and crops and to do so in a forceful manner. The "force," in both cases, have been provided by depth of field and interesting ground patterns. Above is abandoned land of Hall County, Texas; below is prosperous cultivated land of Clockamos County, Oregon

F.S.A. photos, Dorothea Lange (above) and Russell Lee (below)



AFTER HAYING. In composing a landscape, the camera must be moved, as the subject cannot. Even here, where the farming instruments are important, the balance was sought by camera position alone
Photo, Ira W. Martin



MORNING IN THE ADIRONDACKS. The morning sunshine and long shadows, a winding road, and soft focus give a pastoral air to this landscape
Photo, Ira W. Martin

me that pictures can be made which will be pleasing to look at without being too sweet. Maybe they can be made to establish a state of mind or memory without obvious illustration. Maybe they can have an appeal to people who are unable to give a specific reason why they like the picture.

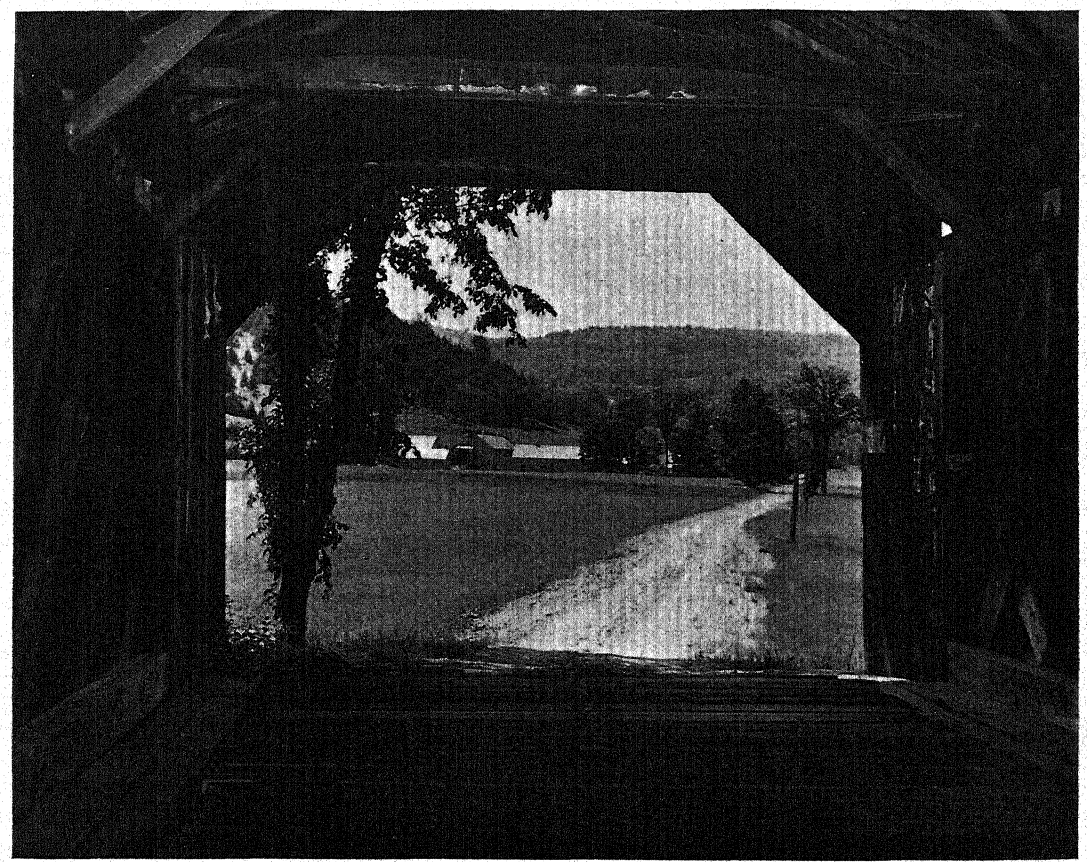
The nearest to this sort of thing the author has been able to produce is his picture, "After Haying." It was taken in the Adirondacks and, like many farmers, this one left the hay rake in one place, the mowing machine in another, but had all the hay in the barn. In taking the picture, nothing was moved but the camera. The composition or arrangement is nothing in particular, but the balance feels right. It was taken against a high sun with a 4 x 5 camera, Dagor lens stopped to f/22, with a yellow-green filter. A tripod was used and an exposure of 1/50 second was given on panchromatic film. The

developing was done in A-B-C pyro and carried far enough to get a full tone scale running from the sun's reflection on the roof to the deep shadows of the barn. A glossy paper is used because it holds the tone scale to greater limits than does a matte finish paper.

The following morning and from a point not over ten feet from where I stood to take "After Haying," I took a picture of the farmer taking the cows down the road to pasture after the morning milking. This picture was taken to the northeast with the sun coming up at the right of the picture, while the other picture was taken to the southwest at about noon. Here are two pictures taken from the same spot and under similar conditions, except for the time of day, yet they are entirely different in their appeal. The one is of an abstract nature while the other is thoroughly pastoral—with the morning sunshine, long shadows across the foreground, a winding road with a bridge across a brook, a man and boy with cows on their way to pasture, and a mountain in the distance. This is distinctly Adirondack's country, while the other picture could be most anywhere and is devoid of all the elements of natural beauty. One has many of the elements used by traditional landscape painters and photographers, while the other is a realistic presentation of a detail of a farm and an unillustrated phase of farm life. It is obvious, then, that it is the approach or attitude of the photographer toward his subject rather than the equipment that determines the type of finished picture.

CONCLUDING WORD

As a concluding word, let us outline a brief program of procedure for those who feel the urge to go out and make landscapes. To



COVERED BRIDGE. Here is a landscape photograph which combined synchroflash and daylight illumination. The flash has brought out the construction details of this old covered bridge and has made a perfect frame for the quiet landscape beyond. Third prize winner in the Kalart 5th Annual Speed Flash Contest
Photo, Edmund Homer Royce

start with, the business of equipment should be completely settled before setting out. Get your lens, camera, tripod, and films. Take them out in the park, in the street, or down the road and try them out. Make some exposures, develop the films, and make some prints. If they do not look right to you, keep on experimenting until you get the character and technical quality in the print which meets with your approval. This will be the result of a certain exposure meter factor, developer, development time, paper and its treatment. This complete combination should be followed carefully and not often changed once it is satisfactorily worked out. The proven films are in the holder or camera and the exposure meter is set for the proven film factor. All there is left to do is to follow the meter.

The next thing is to decide where to go. This should not be difficult because it is just a case of going where the desire dictates. This is sure to place one before a landscape which is interesting to the photographer. He then photographs the thing which interests him most and in the manner or approach which fulfills his interest. If it is the beauty of nature which attracted him to a certain locality, then let him make the most beautiful picture he is capable of producing. If it is the life of the farmer in the field, let him record him in his characteristic surrounding. If it is the historical pursuit, let him study the subject, try to visualize the scene as it was when it made history and make the picture from a vital point of interest. If the scene was chosen on account of some significance, then make that significance dynamic and deliver it to the spectator with an impact of photographic realism.

Here is an obvious truth for a conclusion—get out into the country as often as possible. Just as you cannot photograph babies successfully unless you know and like babies, so you cannot picture landscapes unless you see familiar countryside with the eye of a photographer.

In short, perfect your technic, take an interest in some phase of landscape, go to that locality, and do your very utmost to *record by photography* that thing which interests you. And by all means do it in the way which satisfies you most.

LANTERN SLIDES

A. J. Lockrey

Fotocolor Laboratories, New York; American Photographic Publishing Co., Boston; Author of Halftone Processes

For full tone values and satisfactory luminous qualities, the slide or transparency has many advantages over the black and white print. Such slides are used by the lecturer, advertising man, and others. And, of course, also by the hobbyist. The special sensitive materials used, the technic of slide making by contact or enlargement and reduction, control of density, contrast, and color—all are fully discussed. There are also words on finishing slides, projecting them, and filing them.

See Also Filing For Amateurs, Filmstrips, Projectors

PHOTOGRAPHERS who look upon the paper print as the final goal of all photographic efforts should pick up a good print and look at it critically. You may be pleased with the print, but how does it compare with the original scene? That glow of sunshine on the baby's hair, the dancing shadows, the velvet coolness of the flickering shadows—*those* are the things you saw in the original scene, and tried to capture in your negative and put onto your print. Did you get it? The closer you look, the more you realize that all you have on your print is a series of gray tones—light gray for the sunlighted portions and dark gray for the shadows. You took a photograph of *light* and, in your print, you try to express it in *shades of blackness*. There in a nutshell you have the fundamental difference between your paper print and a transparency—your print tries to tell its story in blackness, while the transparency tells it in *light*, the medium of the original.

Your paper print can give you neither a black nor a white with its shortened scale and its reflection characteristics, while with a properly made slide and a good projector you can not only reproduce the full scale as it originally presented itself, but you can, if you desire, go beyond this scale and show more brilliant highlights and plushier blacks than any natural scene, and they will *look* more natural, more lifelike, and more definitely divided into foreground and background. Details that were lost in the print because the paper was unable to cover the scale will stand out in projection. Pictures taken on sunlit days will look as if the sun

were shining instead of having that London fog effect. And grain, the bugbear of blown-up paper prints, will cease to be a problem because a projected picture *must* be viewed at the legal distance. The blocked shadows of your print will open up when projected and show four or five additional tones of detail you never knew were there.

Once you make slides of a few of your prize negatives, you will regard this as a routine procedure in the future, because no other process will give you the complete satisfaction you will get by throwing a few life-sized murals on your wall at will, and really looking *into* your scene.

TYPES OF TRANSPARENCIES

The types, sizes, and uses of transparencies are as many and varied as are the types of opaque positives, and they can be produced by almost as many different photographic methods, and some that are not so photographic. The type with which the public is most familiar of course is the 35mm Kodachrome transparency, nearly everyone having made or handled some of these. But from this point they range all the way up to mural size, in black and white, toned or tinted, or natural color, and on all types of transparent or translucent photographic material, including glass, paper, and film base, some of the latter forms being on special transparency material carrying its own tint and/or diffusion incorporated in the base or the emulsion.

Color Transparencies. The 35mm and Bantam sizes mounted in 2 x 2-inch glass are by far the most common, both because the projecting equipment is much less expensive and cumbersome in this size and because the size of the slide is relatively immaterial if it is going to be projected. The 35mm size will serve nearly all practical purposes except professional lecture use where there is an unusually long "throw" and much fine detail must be shown. The "professional" size, in this country, is 3¼ x 4, and in England, 3¼ x 3¼. Most 35mm transparencies are either mounted singly in 2 x 2 cardboard mounts, such as the Kodak "Readymount" or between 2 x 2 glass plates, and are kept in some rotational order in slide-file boxes.

The actual size of the projected area of the slide is the usual 35mm double frame—1 x 1½ roughly—and this area may be used either vertically or horizontally, or the full 1½ x 1½ may be used. With the larger 3¼ x 4 slide, the picture area is usually 2¼ x 3¼, and must be used horizontally, and either size may of course be masked down to show any portion of the total area.

Practically all slides of either size are used only for projection, being too small for direct viewing with any comfort unless a magnifying viewer is used.

Above these projection sizes, the uses of transparencies for direct viewing are as varied as the uses of any kind of photograph. They are made into lampshades and various types of lighting equipment, including illuminated wall panels of practically any size. Rotating window displays use them, in some cases producing an illusion of motion by the use of a stationary foreground and a rotating background of clouds, fire, waterfalls, etc. Museums use them frequently to show habitat settings, and the movies rely on them for many of their most effective tricks (see *Background Projection* article). Walt Disney would probably have to go out of business without them.

Filmstrips. For some specialized purposes they are also kept in the original filmstrip form and projected from the strip. This preserves the original order of projection, keeps all of the subjects together, and is particularly suitable for lecture or advertising work (see *Filmstrips* article). Occasionally these filmstrip lectures or advertising talks are also synchronized with phonograph records, the record playing along with the projection of the succeeding slides, the slide being changed whenever the clicking signal is heard on the recording. A special projector or a special gate on the projector is required for use of filmstrips, although some 35mm projectors come equipped with interchangeable gates.

SENSITIVE MATERIALS

Lantern slides or transparencies are positive prints, just like paper prints in this respect, and for this reason they should be made on a positive emulsion for best results. A positive emulsion differs from a negative

emulsion in several respects, being physically thinner, slower, finer-grained, and is usually color blind or occasionally orthochromatic. By the same token these emulsions have much less latitude then negative emulsions, and in the special lantern slide emulsions the contrast control is usually built into the emulsion, as in the various grades of paper, instead of being obtained by varying the development, as is the case with negative emulsions. That is, the plates come in three grades—soft, medium, and contrast. This latter statement is true of course only when materials especially made for lantern slide purposes are used. When ordinary negative materials are used, contrast control is obtained solely by varying development time.

35mm Film Materials. The most commonly-used 35mm slide-making material is Kodachrome. Dufaycolor is also available occasionally, and sooner or later we will have the new Agfacolor, these latter two being home-developable, while Kodachrome must be sent off to Eastman. Another Eastman 35mm film especially suitable for transparency work is Kodak Direct Positive, available only in 36-exposure 35mm and 8-exposure Bantam lengths. This film is used in the camera, developed to a negative, and reversed to a positive, ready for immediate mounting and projection. A made-up kit of developing and reversing chemicals is also available. Eastman positive materials for printing from negatives include their Kodak Safety positive 35mm film, which comes in two contrasts, Regular and High Contrast for line work, and which is also available on order unperforated (Bantam) and with tinted base. This is the same emulsion as the regular professional movie positive film, but on a safety acetate base for home projection.

The most convenient material is the Eastman Lantern Slide Plate, a 2 x 2 plate which is more easily handled than film, and only requires the addition of a cover glass and mask to make a slide. These are available in three grades, Soft, Medium, and Contrast. Their Positive Cut Film and other materials only supplied in the larger sizes can of course be cut down for 2 x 2 use. Afga's 35mm Superpan is also supplied in a reversible emulsion, and of course in the bulk-film field, any reversible positive film may be used. Eastman's Microfile, an extremely fine grain slow pan 35mm film, is also popular, as are Agfa Minipan, Dupont Micrcopy, and Dupont Positive 35mm.

3¼ x 4 Materials. Many more different types of material especially designed for lantern slide work are available in this size than in the 35mm size, although the growing popularity of the 35mm size in this country will eventually result in all emulsions being made available, on both film and plate base, in the 35mm size. The most popular 3¼ x 4 material aside from Kodachrome in the cut-sheet film sizes is the Eastman Lantern Slide plate, available as stated above in three degrees of contrast. The Safety Positive emulsion mentioned above is supplied in cut-sheet film form in this size. Agfa's Direct Copy Film provides direct copies in one operation. Eastman, Agfa, or other makes of commercial film are also widely used, and most makes are available in this size, or can be cut down. In the final analysis almost any emulsion can be made to serve the purpose, when its various characteristics are taken into consideration and the processing is handled accordingly, but the materials especially designed for positive work provide the best results with the least effort.

Materials For Large Display Transparencies. Many very interesting materials are available for larger sizes of display transparencies for direct viewing.

All of the various emulsions on glass plates are used, particularly those favored by the graphic arts for gravure and other positive work. These include Kodalith, Reprolith, Litho, and various other "process" emulsions, which are very fine-grained and easily controlled to produce any degree of contrast desired in the development. Since all large transparencies must be viewed against a smoothly diffused back light, it is common practice to include this diffusion in the transparency itself, either by backing the transparency with groundglass, flowing its back with groundglass substitute, or by incorporating some means of diffusion in the emulsion or the support itself during the manufacture.

All transparency papers automatically take care of the diffusion question themselves. Thin papers especially suitable for

this work include Eastman Translite (made on both paper and film base), Agfa Nokoline, and Defender Velour Black surface "AL" (semi-matte document). The Translite paper is coated on both sides, the emulsion on the back side serving to "back up" the blacks and make them much richer. Ordinary single-coated paper is apt to show weak blacks if too much light is used behind it.

The most beautiful of all transparency materials is Defender's Duolux, a heavy translucent film material with a Velour Black emulsion on the front and a faster ortho emulsion on the back. The softness of the back image, the separation between the two images and the semi-matte surface, and the diffusion combine to give a rich three-dimensional effect. Unlike other film base materials, it can be viewed either by front light or back light, since it is coated on a white base. Frequently the back only is colored and a flasher employed, so that alternately a black and white and a colored image are seen. Defender's Adlux is a similar material, except that it passes a great deal more light and is intended for large and brilliantly-lighted transparencies which must "carry" for a greater distance. It is double-coated with the Velour Black emulsion on both sides and is intended for viewing with transmitted light only.

THE TECHNIC OF SLIDE MAKING

Slide making can be as simple or as complex as it is your pleasure to make it. The process ranges all the way from the ultra-simplified shooting of 35mm Kodachrome rolls and having them returned to you by Eastman in Readymounts, to the most complicated technics of trick, combination, toned, or natural-color work. In fact, practically every photographic process and method is used in much the same manner as it is used for opaque printing, with due regard of course for the fact that the viewing light passes through the image instead of being reflected by it. For this reason, we will not dwell too much on the general photographic procedures, but will devote our space mainly to the differences between this and opaque work.

The Negative. As in any other type of photography, the better the negative the better the print, except that this difference is intensified in the case of slides. The degree of magnification is usually so great when an image is thrown upon a screen from 2 x 2 that the faults of the miniature negative, in the way of scratches, pinholes, and airbells, are embarrassingly apparent. Only the cleanest and most carefully-processed negatives should be used, as the final result is so small in size that retouching is difficult if not impossible and results seldom justify the effort. If the negative is valuable and irreplaceable, and must be reproduced, the best solution is to rephotograph an enlarged and retouched print. Grain is not as vital a question as might be supposed (although it must of course be normally fine) because projected images are never viewed as closely and critically as a print. Contrast should be as near normal as possible, but, granting the absence of totally blocked highlights or blank shadows, the greater contrast control possible in the slide-making process and the greater contrast range of transmitted light make it possible to produce better slides, on the whole, than prints from the same negatives.

PRINTING BY CONTACT

If the negatives to be printed are the size which the finished slide is to be, or if only a portion of a larger negative is to be printed "same size," contact printing is the simplest method, using either a contact printer, a printing frame, or a vertical enlarger, laying the negative and sensitive material on the easel, and using the enlarger light to expose with. I prefer the latter method because it is easier to position the material, a certain amount of dodging is possible, and it is not necessary to cover everything else up while making the exposure. A controlled and directed light source such as the enlarger also makes sharper prints than a diffused light source, as it acts more like a spot source, and the lens stops of course are a great convenience in adjusting the exposures to a comfortable length.

When using a printing frame or contact printer, absolutely perfect contact between negative and positive is necessary, as the slightest buckle or separation will make the fine detail fuzzy. And the two emulsions

must be face to face, with no mask intervening. When using a spot source (small intense filament 4 or 5 feet away) or when using light projected through the enlarger lens, the question of contact is less critical, and masks may even be used or the negative emulsion may even be away from the positive emulsion, if desired for purposes of reversing lettering, etc. in combination printing. This latter question seldom arises in straight slide making, however, as it is always possible to turn the slide over when projecting it.

Framing. Framing in these small sizes, particularly when the framing of the negative is to be different from that of the positive, calls for close work but is not difficult to master after a little practice. If the copy is to be framed exactly like the negative, then the two are simply squared up with each other, ignoring the mask, and the exposure made. If they are different, the simplest method of framing is to hold the 2 x 2 mask over the negative and look through it until the desired framing is secured. Then tape an L-shaped cardboard "locator" to the easel and lay the mask and negative over this, with the mask underneath and fitting into the L. Then hinge-tape the negative to the easel in this position, remove the mask, insert the positive slide and make the exposure. If the negative is thin film, lay a sheet of clean glass over it. It is not necessary to print through the mask, as the final mask covers all extraneous matter when it is bound up into the slide, and a little miscalculation might leave a white line around one side of the finished slide area.

Printing by this method on cut-sheet film is done in the same way as when working with glass slides, as this material lies perfectly flat. But 35mm roll film is quite another matter. In fact, it is so difficult to handle in short lengths that it is better to work with other materials, or to use it only in the camera. Strip printing frames as well as single frames are available in the 35mm size, however, and this material is the least expensive of all. When using a printer or printing frame of course the above procedure is reversed, the negative being taped down with thin slide binding tape, the mask positioned and hinged over it and used as a guide to tape down the L-shaped "locator" against which the positive material is placed after removing the mask.

ENLARGING AND REDUCING

Most slide work involves enlarging or reducing, as this permits cropping and otherwise improving the composition, and permits the use of any size of negative material. Enlarging is most conveniently done in the enlarger and reducing in the camera, although some workers use either the camera or enlarger exclusively for both purposes, and occasionally also for "same-size" copying. Many prefer the camera, especially for reductions, as few enlargers have sufficient lens extension to permit reduction printing, while few cameras have sufficient lens extension for enlargements.

A very convenient method of using 35mm roll film in projection printing is to utilize a 35mm camera as a film magazine beneath the enlarger. I use an old Argus for the purpose (Fig. 1). The entire lens assembly is removed and the film is wound in the camera in the usual way. A guide and focusing dummy must be

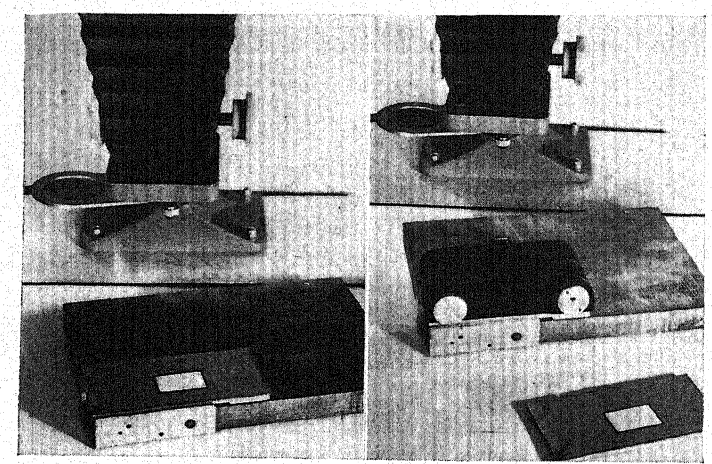


FIG. 1. Using the Argus as a film magazine. An enlarger and camera may be used for slide making and the set-up is shown here. At left is the focusing dummy in place against the guides; at right is the 35mm camera (lens removed) in place ready for exposure by projection

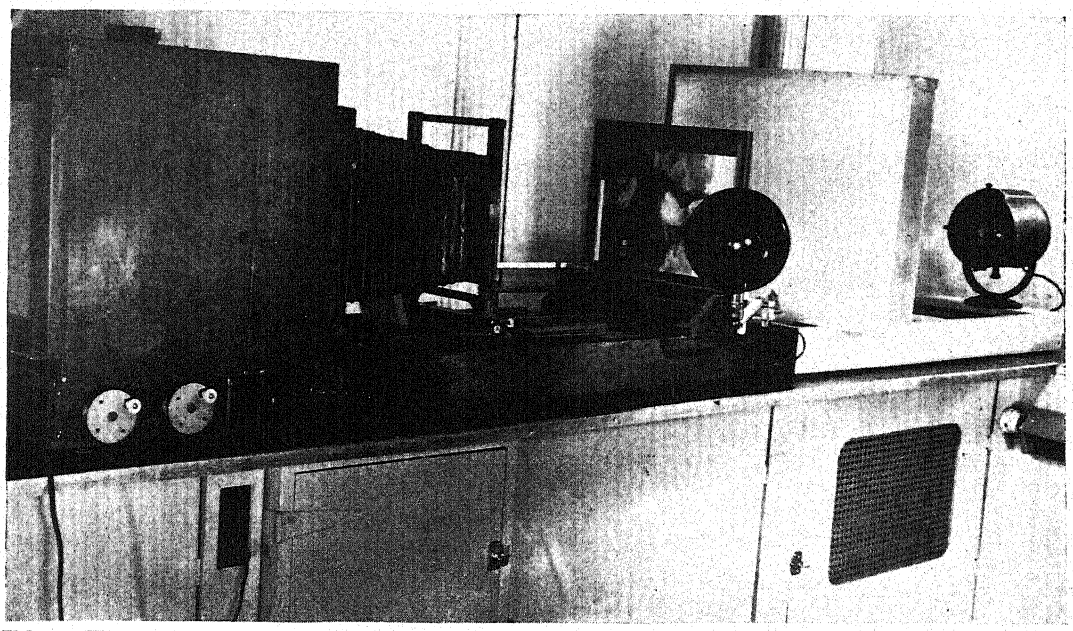


FIG. 2. This copying equipment was built by the author and takes everything from 2 x 2 to 11 x 14 on the easel and in the camera. This shows the front and rear illumination of the copyboard and the diffuser behind the board illuminated by a Fresnel Photospot. The central 8 x 10 view camera has additional 6- and 12-inch removable back extensions, and both lensboard and copyboard are controlled by cranks at the back, as shown. The diffuser is composed of two matte celluloids 4 inches apart, lighted with a spotlight which does not give shadow rings

constructed, as you cannot of course focus and frame on the film itself.

The ideal camera for slide work has a groundglass back, takes sheet, pack, or plates, and has double extension. "Blind" cameras (without groundglass backs) with copying or portrait lenses are clumsy. to work with, difficult to focus, frame, and crop. For easy work, and particularly for material which must be copied "on location," I use a Speed Graphic 3¼ x 4¼ with a normal and a short lens, and adapters to handle various types of sensitive materials.

But for difficult and unusual work, I went the whole way and built a "last word" contraption which takes everything from 2 x 2 to 11 x 14 on the easel or in the camera, front or back lighting, lenses from 2 to 24 inches, capable of anything from 30x enlargement to 30x reduction. As will be seen from the illustration (Fig. 2) it is built around an 8 x 10 studio camera, with detachable extension backs of various depths, with both the lensboard and the copy holder controlled from the back end by cranks, so that you can direct the whole operation from the caboose without having to run up to the front of the train to move the copyboard or lights.

Going back to more orthodox equipment, the practice of copying slides in an ordinary camera is no different from any other kind of copying (Fig. 3). Illumination should be even (and of the proper temperature if you are using Kodachrome), reflections should be avoided, and transparencies must be lighted perfectly evenly from the back with a hood in front of them to prevent stray light from reflecting off their front surfaces.

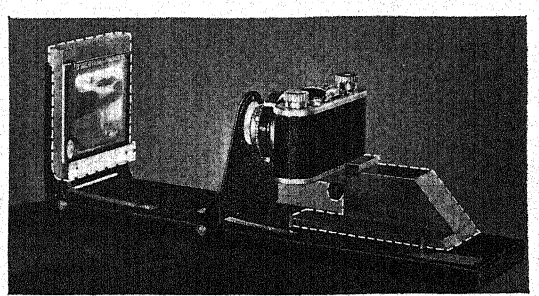


FIG. 3. Lantern slide making by copying does not differ radically from normal copying, but special equipment may be had which makes the job easier. Here is the Cine Kodak Titler and Kodak 35 adapted to reduction slide making. 3¼ x 4 originals are easily made into 2 x 2 slides by this set-up

USING THE ENLARGER

The enlarger however is the most versatile tool for this work, as it permits access to the positive for control purposes. There are no slide or film holders to fool with, and you can see what you are doing. Guides can be quickly taped to the easel, multiple-exposure work is simplified, and a set-up can be changed in a moment.

Practically any enlarger will do the work, the only difficulty with some being that they do not have sufficient lens extension to do same-size or reduction work. In such cases, however, it is no great difficulty to rig up an extension lens tube which will give you practically any extension you want. The question may also be solved by getting an additional lens of shorter focal length. Fortunately both my enlargers—the DeJur Versatile (Fig. 4) and the 5 x 7 Elwood—have sufficient extension to take care of practically anything. Either the Elwood with a 5-inch lens or the DeJur with a 2-inch lens will go down to 75% reduction (¼ negative size).

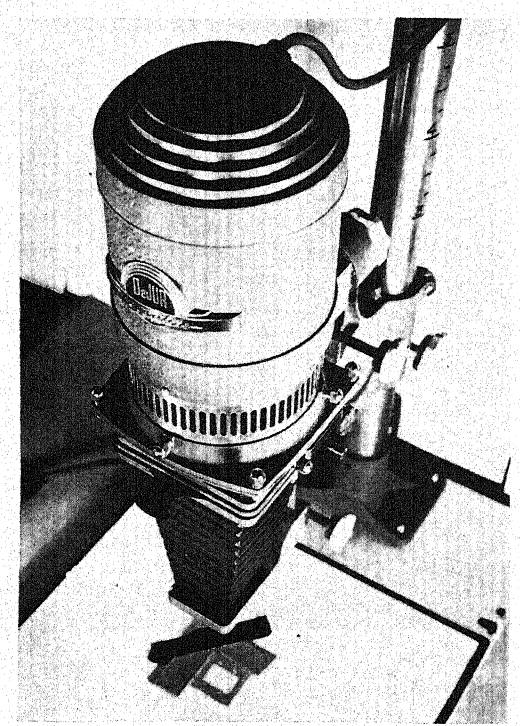


FIG. 4. The DeJur Versatile enlarger set-up for slide making. The fundamentals are: a double-extension bellows enlarger focused on a masked slide against a cardboard guide which has been taped to the easel with framing as desired

The DeJur (2¼ x 3¼ size) with the normal (3½-inch) lens will produce a 40% reduction at its greatest extension. The newer Federal enlargers with bellows all have 7-inch lens extension which permits same-size projection with the 3½-inch lens, or reduction with the extension tube or shorter focus lenses. The Eastman Precision enlarger may also be used for lantern slide work (Fig. 5).

For those who have metal-bellows enlargers having only normal extension, a little ingenuity can easily contrive an extension that will make possible any desired degree of reduction. Some low-priced en-

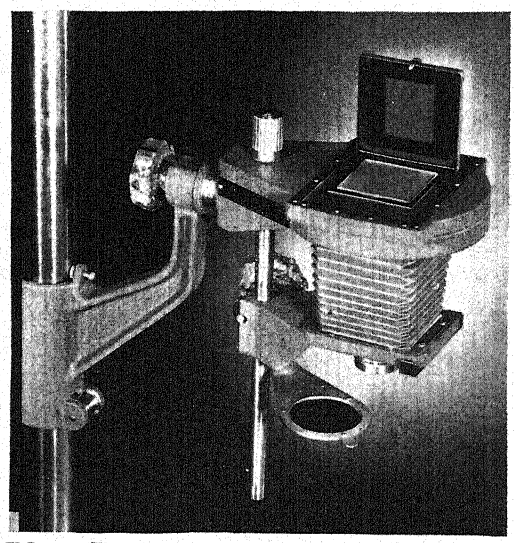


FIG. 5. The Kodak Precision Enlarger with Lantern Slide Adapter A

largers do not even have sufficient extension to make a same-size print, which requires just twice the focal length of the lens. However, all that is needed is an enclosed chamber that will move the lens a few inches out, light-tight and firm. Cardboard tubes, tin cans, wood, or composition material may be used, and the exact method will depend on your machine and your ingenuity. As an illustration of the technic, Figure 6 shows how I added 4 inches to the extension of a Federal No. 245 enlarger. This consists of an empty hypo can, painted dead black inside, the open end being attached to the enlarger by scotch tape. Of course your enlarger may have an extension tube as an accessory, or again it may be possible to solve your problem by using a shorter focal

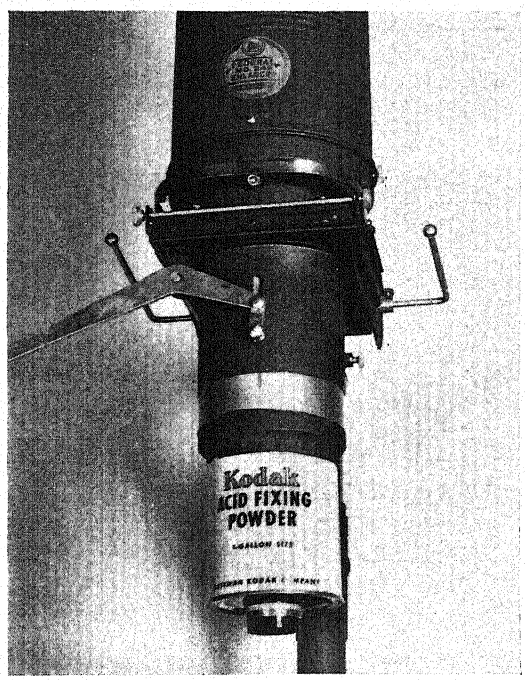


FIG. 6. A homemade extension tube is shown. Black tape attaches the hypo can to the enlarger, the inside of the can is painted black, and the lens is inserted at the other end by being screwed into the rough circle of a jagged hole slightly smaller than the thread diameter of the lens. This technic, of course, is not advisable for an expensive lens, but can do little harm to an inexpensive one

length lens. In arriving at the latter decision, remember that at double extension, a lens will cover twice as big a negative as it is normally rated at, e.g., a 2-inch lens will cover a 3¼-inch negative without vignetting, at double extension.

The only other difficulty in using an enlarger for printing same-size and reduction slides is the difficulty in judging correct focus in this small size. The space between lens and easel is so short that you will nick your head many times on the slide carrier while trying to get in close enough to see. The solution to this is one of these offset magnifying focusing devices, such as See-Sharp. But remember that when working at such short throws, the slightest inaccuracy will put you out of focus, so the See-Sharp or whatever must be placed on top of a piece of dead sensitive material or something else *exactly* as thick as the material you plan to use.

I prefer a larger magnifying focusing device, which will show me the composition as well as the focus, so I made the magnifying table shown in Figure 7, which anyone can easily construct.

Titles. The insertion of photographic titles and other matter is easily accomplished with this magnifying easel and registry device. The typed, printed, or copied title is photographed and projected directly onto the exposed slide, before development. Negative lettering may be projected onto lighter portions of the picture, positive lettering on film may be laid directly over the sensitive

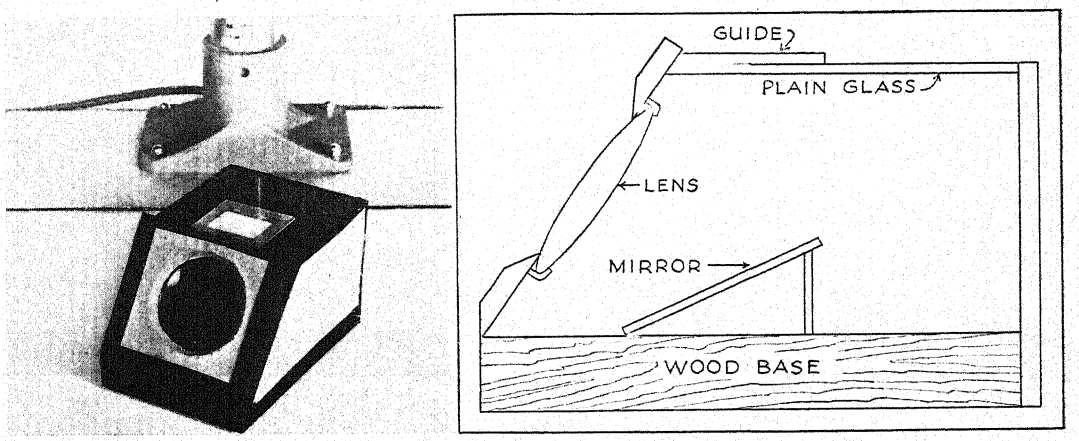


FIG. 7. An offset magnifying focusing device will be particularly handy in slide making, where the lens-to-base distance is so small. At the left is shown the author's homemade focuser which also permits a study of the whole composition; at the right is a diagram of construction. Made of heavy cardboard taped together, it supports a sheet of 4 x 5 clear glass on which a guide for slide alignment has been taped. Under this, at an angle of something less than 45°, is a mirror and, at the proper distance, a simple hand magnifying glass of about 6 inches focus. The groundglass focusing slide is laid on the glass against the guide, the negative is framed and focused, the groundglass is replaced by the sensitive material, and the exposure is made

emulsion in the darker portions, serving as a mask, or the emulsion may be masked during the picture exposure and the lettering projected later.

EXPOSURE AND DEVELOPMENT

These two factors are placed under one heading because they are intimately and inextricably tied together. Your entire control process depends on the variation of the two with reference to each other, so you can't say that a certain plate or film calls for a certain exposure. In fact the same plate, with the same degree of enlargement

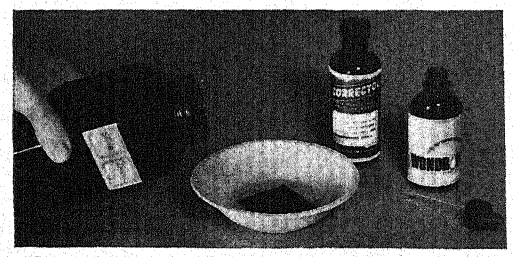


FIG. 8. Only an ounce or two of developer is needed for a 2 x 2 slide and, when used once, it should be discarded. A wetting agent is good in all solutions to prevent spots and a cutting reducer will brighten highlights

from the same negative, might have a half-dozen "correct" exposures, all the way from 10 seconds to 70 seconds, depending on the degree of contrast and color desired, and the developer. This is a far cry from ordinary paper printing, but that is what makes slide-making so interesting. You will find that after you learn to make a good slide, you will know a lot more about emulsions and will be able to make your camera do what you want it to do, instead of getting a surprise every time you make the first print from a negative for which you strove to get a special effect by exposure and development.

Unless special effects are desired, as outlined below, any developer may be used for slide work except the soft-working negative developers like D76. Usually, the package of sensitive material will carry its own suggestions as to the proper developer for slide work, and in general it is best to follow these in each case rather than to use one developer for everything, due to the differences in emulsions.

Extreme care and cleanliness are necessary in slide making, because every blemish is magnified. All glass surfaces must be clean, finger marks must be avoided, and brisk agitation employed. The use of a wetting agent such as Wondrop is strongly recommended to minimize uneven wetting, air bells and spots (Fig. 8).

Briefly stated, the most important laws of exposure and development are two: (1) Short exposure with long development gives contrast; long exposure and short development give softness. (2) Depending on the developer used and the exposure given, the "color" of the finished image is governed by length of development. Both statements apply to paper prints as well, but to a much lesser extent because of the thinness of the emulsion and the principles of reflection. But with slides, you have a real emulsion to play with, and it will respond gratifyingly to wide variations of treatment.

Controlling Tone. By "color" here we do not mean natural color, such as Kodachrome, nor do we mean the vivid colors produced by tinting or chemical toning. "Color" in a black and white slide generally means only that subtle range of blacks, from the cold blue-black up to a warm deep sepia, all of which are produced by no other treatment than the compounding of the developer and proper gauging of the exposure and development times. The "color" is an optical illusion produced by variations in the size of the silver grain. A developed image consists of a mixture of silver grains or clumps of all sizes. The coarser grains absorb all of the wave lengths of light evenly, producing a cold black, but the finer grains absorb greater or lesser amounts of the short wave length colors such as blue, passing proportionately greater amounts of the warmer reddish colors. By proper control, tones may be produced all the way through brown to light sepia, purplish, reddish, and even yellow tones, all without the use of any pigment, dye, or chemical changes. Some people never go into it this far; others make a hobby of color control. The average person looking at a print never notices whether it is a cold or warm color, but if you will compare your own bromide enlargements with the color of an expensive professional portrait you will see the difference quickly enough.

CONTROL OF VARIABLES

As stated above, all three factors—density, contrast, and color—are tied up together, and are controlled by variations in exposure time, development time (and temperature), and developer composition. This sounds like quite a mess, from the standpoint of arriving at any sort of definite control, and it is, until you learn to separate the variables into steps and handle them.

Density. In the first place, eliminate one unnecessary variable — temperature — entirely, by always working at the same temperature whenever you are trying to produce given results. Second, as to exposure: exposure governs density, and should be varied for no other purpose than to obtain a desired density. The density you want depends on "throw" and projector power—you will need a thinner slide if you have a long throw such as a lecture hall, or if you have a low-powered projector. Determine this density and then work to make all slides the same. Make step exposure tests (2, 4, 8, 16 seconds, etc.), develop for an exact time in the recommended developer at the recommended temperature, then choose the step which gives you the best density.

Contrast. That takes care of one variable. The second—contrast—is governed by length of development, with any given slide and developer. First choose the type of sensitive material and the developer which best suits your purpose and your negative, then find the correct exposure to get the desired density, then develop several tests (identical exposures) for various times—say 1 minute, 2 minutes, and 3 minutes longer than the recommended minimum time. A comparison of the results will immediately show your best contrast and how to get it. Of course if your negative is normal, then normal development on a normal plate will give you the proper contrast.

Color. This leaves the third variable—color. Of course you can skip the whole subject of color, and let them come out any way they please as long as the density and contrast are right. Most people do. Or you can confine your color activities to the use of two developers, one producing a warm tone and the other cold tones, such as Eastman D32 for warm tones and D34 for cold tones. Or, you can produce a certain amount of variation with good old D72—a universal developer if there ever was one. For normal development, use it 1:2 for 1 to 1½ minutes; for warmer tones, dilute to 1:3 or 1:4 and develop about a minute longer, after adding a squirt of 10% bromide to hold the fog.

The real color control developers are those utilizing the peculiar properties of a silver solvent, which eats away the bigger grains, eating more and more as development time is prolonged, producing finer and finer grain, and warmer tones. Of course this prolonged development time calls for healthy doses of bromide and this in turn calls for greater exposures, a sort of endless circle. But it can be worked out into a system as follows:

THE M-Q BLACK AND WHITE DEVELOPER

Solution A

Metol	5	grams
Hydroquinone	2.5	grams
Sulfite	25	grams
Carbonate	18	grams
10% Potassium Bromide	5	cc
Water to make	1000	cc

THE COLOR PRODUCER

Solution B

Ammonium carbonate	10	grams
Ammonium bromide	10	grams
Water to make	100	cc

The ammonium carbonate (get it at the drug store) must be fresh, or if there is a crumbly white powder on it, this must all be scraped off, and it is to be dissolved cold.

The only way to produce duplicate results is to use fresh developer each time, and since this might prove a little expensive on a tray-full basis, there is no reason for using more than an ounce or two each time, in a small tray or saucer, on 2 x 2 slides. The exposures, development times, and developer composition for the complete color range possible with this developer are as follows, using one ounce (30 cc) of the straight MQ developer solution each time:

Amt. Solution B	*Exposure-Ratio*	*Develop-ment-Time*	*Color*
None	1	1 minute	Olive-black
2 cc	1½	2	Warm black
4 cc	2	3	Sepia
7 cc	4	4	Sepia-brown
10 cc	6	6	Brown
15 cc	20	8	Purple-brown
20 cc	120	6	Red*

* For the last color, only a very hard negative can be used, as contrast is so greatly reduced by the shortened development ratio.

Another method of gauging the development time is to develop for a period which is a definite multiple of the length of time it takes the image to first appear—called the "Watkins factor system." By doing this you can reproduce over and over again the identical contrast regardless of other variations in the system. In other words, instead of developing for a certain number of minutes, develop for a Watkins Factor of 5, which means 5 times the length of time before the image first became visible. If this figure were 20 seconds, the total time would be 100 seconds, or 1⅔ minutes. Applied to the above table, the factor without any Solution B would be about 10, and with the solution about 5, dropping to 3 on the last color (see *Factorial Development*).

Sometimes it is impossible to secure the exact combination of contrast, density, and color you want, usually because the contrast of the original negative is so far off that the control processes described above cannot fully compensate. In such cases, there is nothing else to do but intensify or reduce the negative to alter its contrast (see articles on *Intensification* and *Reduction*). In the final analysis, best results will be secured—in this branch of photography as in any other—only by so exposing and developing your original negative as to give you normal contrast.

JUDGING EXPOSURE

At this point it might be noted that the appearance of a slide during development with any considerable portion of Solution *B* in the developer is quite different from that of slides developed in ordinary MQ developers. The image as it first comes up is a fuzzy dim yellow, very difficult to see under the safelight, and difficult to judge either as to density or color. Some idea may be gained by looking through the slide at the safelight, but the best system is to work by time alone, and examine the slide after it has gone into the hypo. Even then appearances are apt to be slightly deceiving, as the contrast of a wet slide is usually less than that of a dry slide, and its color warmer, so allowances for both must be made in forming judgments.

If you can't wait for your slide to dry before projecting it, and do not mind dirtying up your projector, project it for only a moment while *wet with hypo*, after only a superficial rinse. If you wait until the hypo is washed out, the first touch of heat will shrivel it up. Another good system is to construct or obtain an extra negative carrier for your enlarger, and use this to hold your wet slides for test projection on the easel.

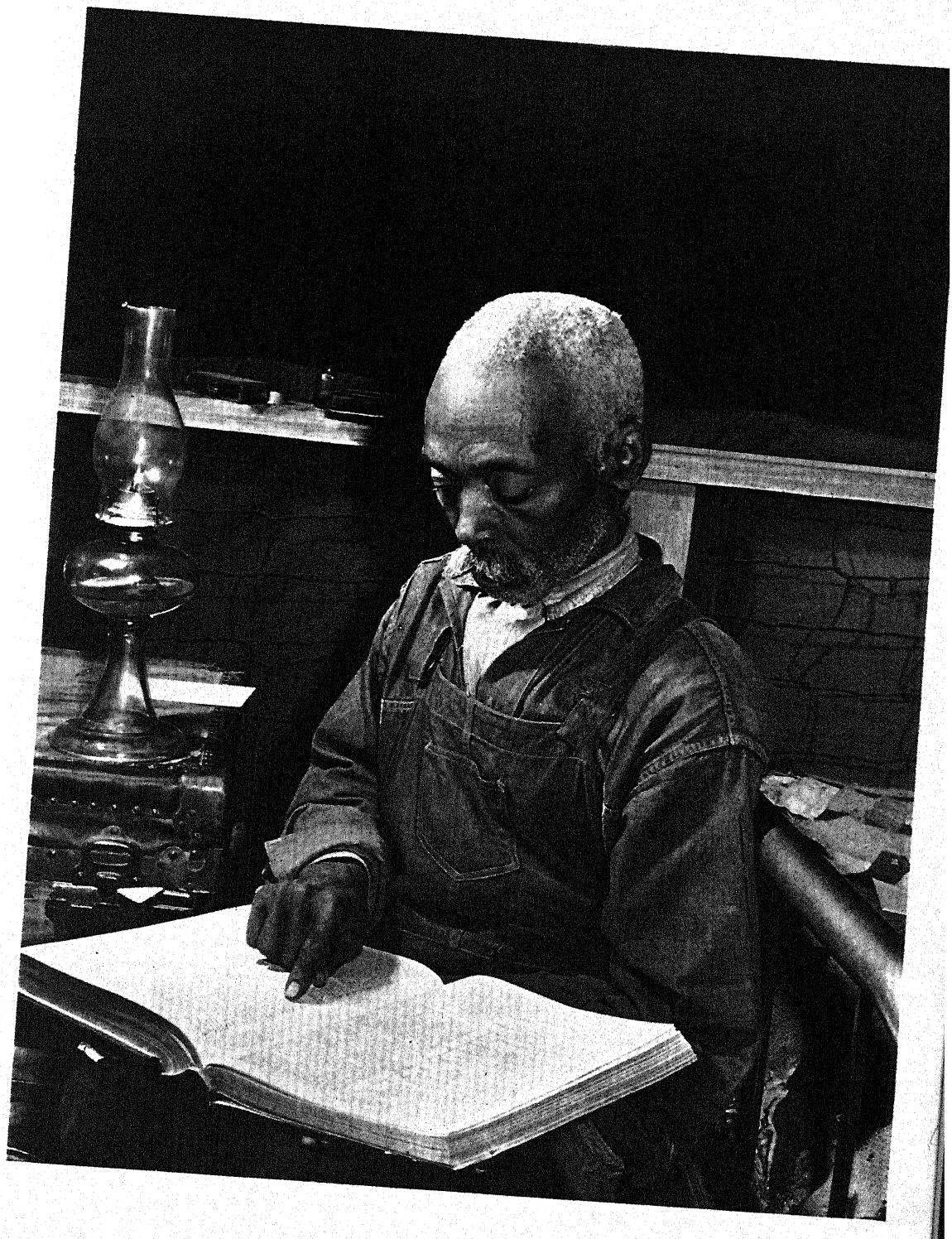
Test Strips. The only way to arrive at correct exposure times is by step test exposures, making a series of exposures of a small portion of the image, each step receiving double the exposure of the previous step. You do not need to burn up a box of plates doing this however—you can use the cheapest film or paper you have on hand, establish an exposure ratio between it and your slide material, and then make your tests on the former. Take a strip of each material and place them on the easel side by side, and project a uniform pattern of some kind onto them, making sure the image falling on each is identical. At the end of 2 seconds, cover a narrow strip of both, at 4 seconds another, succeeding strips at 8, 16 and 32 seconds. Develop simultaneously and locate the two sections of identical density. This gives you

(Continued on page following insert)

COMPOSITION ANALYSIS for . . . EVICTED SHARECROPPER

In line with the great work of the government's Farm Security Administration photography, the veteran Rothstein gives here a fully felt but unglamorized portrait of a man who keeps his dignity in the face of eviction. Rothstein lets us into his life in this setting of meager uprooted household things. We see the finely shaped head with the twist of worry lines creasing a brow made to be serene. We see quiet concentration and self respect, clean work clothes, the earnest work hardened finger searching for some comfort in the "Good Book."

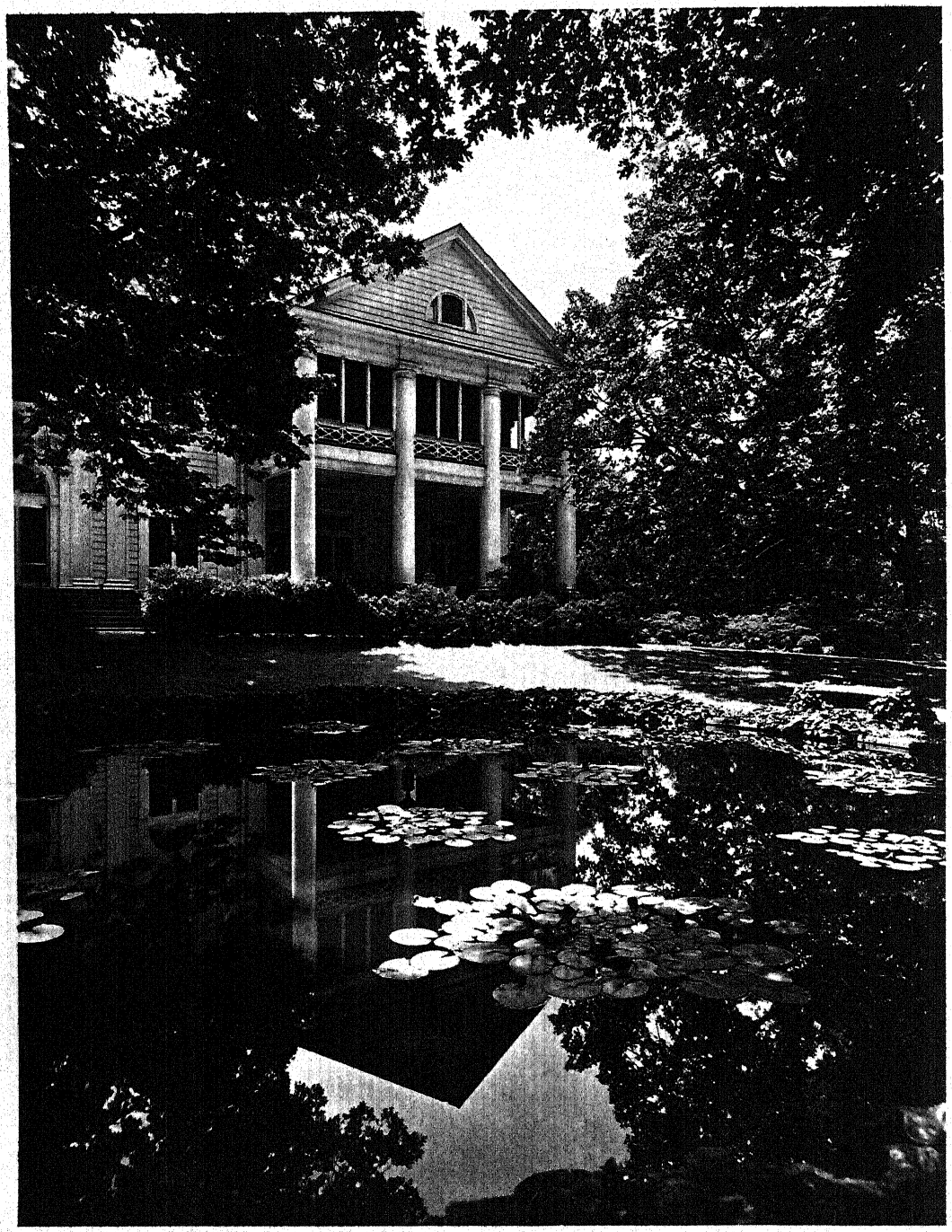
Searching through this honest picture, whisker by whisker, seam by seam, finding goodness of heart, it is hard to balance up any social justice in an eviction. That the picture arouses this sense of injustice done to a citizen shows that it accomplishes its purpose. It was not intended to be pictorially beautiful, but rather a plain fact about the state of life in our nation which needs to be faced and improved. However, in setting directly at this task, Rothstein has succeeded in making a strongly composed arrangement of touching beauty. His use of the horizontal bedboard emphasizes the absorbed expression of the ovoid head. Lamp, trunk, Bible, and bedstead bind in the central figure with a homely conviction. The small-scale still-life of the ever-present patent medicine bottles approaching the illuminated dome of the head is important overtone in the composition structure and significance. Altogether it is a picture of great sincerity and simple power. ***Barbara Morgan***



EVICTED SHARECROPPER

ARTHUR ROTHSTEIN

A Farm Security Administration photograph taken in Butler County, Missouri



NORTH CAROLINA RESIDENCE F. S. LINCOLN

This is a fine architectural view with practically perfect composition and exposure. And notice how the areas of shade and the mirror-like pool give the impression of coolness and quiet. The reflected image has been broken by pond lilies, so as not to detract too much from the real subject—the house



LABORATORY F. S. LINCOLN

This straightforward photo of a laboratory technician at work was taken for the Interchemical Corporation Laboratory of New York. Its purpose was not to give a dramatic effect, but to show the process of testing enamels. The depth of field makes every part of the picture in focus, even the writing in the foreground notebook



SALY SPENCE — LOTTE JACOBI

This interesting portrait is characterized by a bold and effective use of black and white. The hat—which shows at the top for identification—sets off the blonde hair; the necklace gives interest to the lower part of the picture and it also complements the shape of the forehead. Done with simple photoflood lighting

(*Continued from page preceding insert*)
your ratio. This can be brought down to a more exact point by making a second test on the closest steps, exposing the slower material for the step in question, and the faster material in two or three steps 20% above and below the closest step on the first test. Again develop simultaneously and you can usually find an exact match. The easiest way to use this ratio is to make your tests on your test material to find exactly the density you want, then expose the slide for the same length of time but at a different lens stop to compensate. If your paper test is exposed for 10 seconds at f/11 for example, and your ratio is 2X, then your slide should be exposed for 10 seconds at f/8. This will avoid unduly long exposures if one of the two materials is very slow. Even contact papers can be used in this way, although the ratio would be awkwardly high. Regular bromide papers are best, their speeds averaging from ½ to ⅛ that of lantern slide plates.

Bromide papers, in their various grades, may also be used to judge the contrast of the negative, and as a means of varying the exposure and development to secure the desired contrast in the slide. If your negative looks soft, make a print on No. 3 or No. 4 bromide paper. The resulting range may be duplicated on a medium or contrast plate, with still further variation possible—softer by longer exposure and shorter development; harder by shorter exposure and longer development. If you have a hard negative, try it on No. 1 or No. 2 bromide paper, then print it on a medium plate, with moderately long exposure and slightly shortened development. If your negative is extremely hard, try the special soft plates, with long exposure and short development.

AFTER-TREATMENT

The various reducing and intensifying processes can all be used to good effect on slides, as well as on the negatives from which they are made. Since these processes in no way differ from those used in other branches of photography, no details or formulas are included here. The most common after-treatment is reduction, not so much for the purpose of reducing density, but more to merely clear the highlights and remove any traces of processing fog. Some people make a practice of lightly "cutting" all of their slides for this purpose. Farmer's Solution is probably most commonly used for this purpose, although the ready-mixed and longer-lived Correctol is much more convenient.

FINISHING SLIDES

Masking. With the exception of Ready-mount Kodachromes, all slides must be mounted and bound, glass slides being bound with a mask and a plain sheet of glass over the emulsion-bearing glass, and film slides being bound in various ways: taped between two pieces of glass, in cardboard Ready-mounts, or in metal-glass mounts.

All slides must be masked (Fig. 9), as the area covered by the projector lens is calculated with the masked size in mind, and if an attempt were made to cover the whole slide area (2 x 2 or 3¼ x 4) there would be inevitable loss of definition and distortion at the corners, as all projector lenses are relatively cheap and are uncorrected lenses which work at maximum aperture. A projector lens is seldom if ever stopped down, no provision even being made for this in most projectors, because every stop down would call for doubling the light, and the whole battle in projector design is to get enough light.

The maximum allowable size of the masked frame is 1-1/23 x 1½ for the 2 x 2 slide (Bantam size) or 29/32 x 1-5/16 (35mm regular double-frame size) and 2¼ x 3¼ for the 3¼ x 4 slides, although the standard mask size for the latter is more usually 2¼ x 3. These sizes vary slightly, so the best method is to measure the gate in your own projector before starting to make odd-sized masks.

Masks for the 2 x 2 slides are best bought ready-made, as it is difficult to cut a clean edge and corner in this small size, and impossible to cut a rounded corner (Fig. 10). Moreover, the ready-made masks have one side silvered, this side being placed toward the light and cutting down the amount of heat absorbed by the slide. They also usually have tabs which accurately locate the 35mm or Bantam film without fussing around, and which may or may not be used,

depending on the framing you desire. Ready-made masks for the 3¼ x 4 slides are also available in great variety, usually in thin black paper, and for general work are greatly to be preferred to cutting your own, as nothing looks worse than a ragged mask edge when it is blown up on the screen. A clean edge for odd sizes may be produced however by the use of masking tape instead of black paper. Masking can also be done photographically by laying a mask-shaped card over the image area after exposure and "burning in" the edges with a subsequent plain-light exposure. There is some danger of halation and soft edges with this process, however, unless the second (or masking) exposure is exactly "on the button" every time. This system is to be recommended only when conditions require it, since cheap and effective masks may be bought.

Sealing. Every glass-bound slide must be warmed before sealing up with tape, to drive out the moisture in the emulsion. Otherwise the projector heat will drive it out and it will

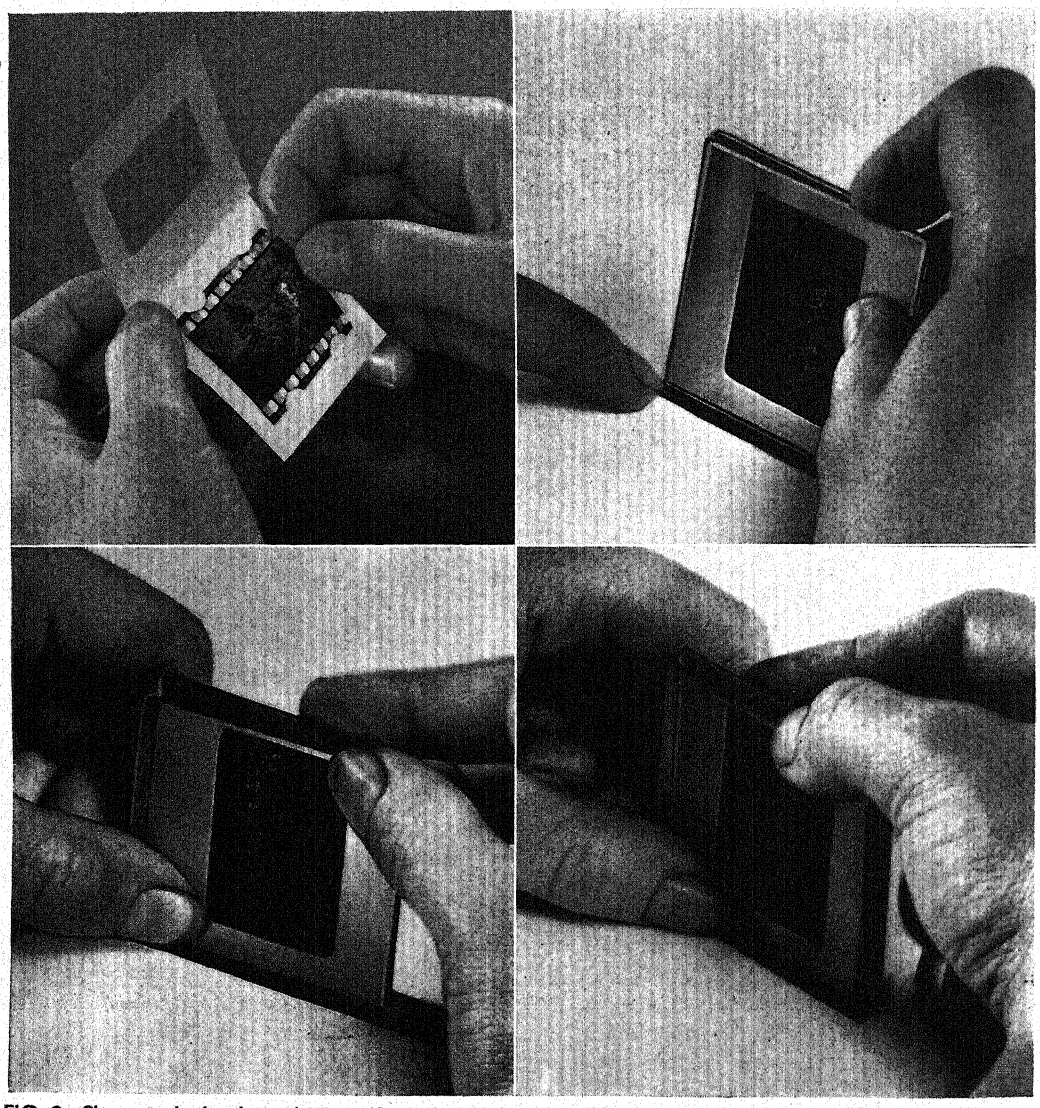


FIG. 9. Shown is the binding of 35mm film with Kodak materials. First insert the film under the tabs in the mask (top left), then place the assembled slide on the gummed side of binding tape (top right). Roll the slide along the tape until three sides are covered and then press down one side at a time (below left). Finally, cut the tape and square off the fourth edge

condense on the inside of the glass and fog the projection. This is especially true of slides bound up during the summer or damp weather, when the relative humidity is 40 or above. Slides bound in winter in steam-heated apartments, when the humidity is down around 15 or 20, never give this trouble. A moderate warming-up on the print dryer or radiator is sufficient.

Film bound between two pieces of plain glass which is smaller than the glass, should be locked in position before sealing up, using small bits of masking tape and taping either to one glass or to the mask, to prevent later movement from the desired position. Ready-mounts of course and some other ready-made 2 x 2 masks have little tabs which serve this purpose.



FIG. 10. The Kodak Slide Kit, containing all materials necessary for slide binding—including masks, tape, glass, and labels

Kodachromes in Readymounts, of course, are not very well protected, the film in fact being exposed to the tender mercies of any tyro who wants to finger it, and the plain cardboard mounts become frayed and soiled with handling. An ingenious means of protecting the film and mount is provided by a product called Cova-Slides, which consist of two pieces of clear 2 x 2 acetate, gummed on one side, which are pasted to either side of the Readymount, covering film and cardboard and stiffening it as well.

Varnish. If slides are to be exposed to damp air and are not hermetically sealed, they should be varnished for permanence and to prevent the moisture from condensing on the glass during projection. To do this, warm the slide until it is as hot as the hand will bear, then flow it with any good film varnish, such as Cinelac, Eastman Lantern Slide Varnish, Wipe-On varnish, or gum dammar in benzene. These seal the gelatin and prevent it from absorbing further moisture, and it also protects toned slides from oxidizing.

Thumb Marks. To save fiddling around and mistakes at the time of projection, all slides should have what is called a thumb mark, which is a little white label (Dennison No. 251) which can be purchased at camera or stationery stores, or colored "dots" such as Dennison's No. 12 Dots, which come in various colors for indexing and sorting by subject. This little label should be applied to the *lower left hand* corner when the picture is upright as you view it in the hand (Fig. 10). Then the slide is always inserted in the projector, as you stand behind it, with this label under your thumb, in the *upper right-hand* corner of the slide. Index and other code numbers can be written or printed on the label.

Heat Sealing. Another air-tight and permanent method of sealing slides, much more simple and convenient than the above, is by the use of the new Albert Thermo-Sealer (Fig. 11). This system consists of a special thermoplastic-impregnated mask with tabs, into which the frame of film is placed; this assembly is sandwiched between two pieces of plain 2 x 2 slide glass, and the whole inserted between the jaws of a heater which looks like a notary public's seal. Within thirty seconds the plastic has melted and sealed itself to the glass all around the borders of the mask, and the slide is finished. No tape or frame is needed, and the slide is hermetically sealed. A little experimentation may be needed to get the exact heating time, which may vary from 15 to 60 seconds due to variations in line voltage or other conditions.

As mentioned above, the films should be dried out carefully before sealing up, or the film will fog up with condensed moisture every time it hits the hot projector, and, being sealed air-tight, there is no way this moisture can escape. The easiest way to do this is to lay the films on a warm radiator or lamp for a few minutes. The film itself is not touched by the adhesive, except around the borders. The system may also be used with cut film or with glass slides.

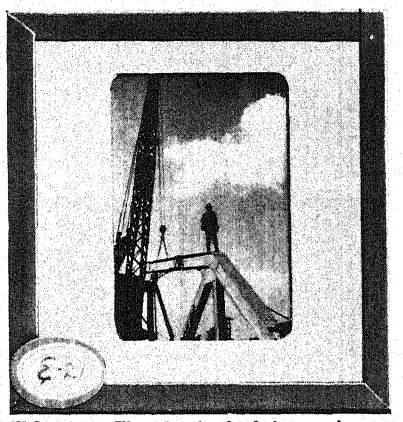


FIG. 11. The finished slide is shown with the thumb tab in place

RETOUCHING

This is something I don't believe in, personally, but there are some people who do very good work, at least in the 3¼ x 4 size. About the best that can be done successfully by the beginner is touching out pinholes in the denser portions with opaque—but you shouldn't have had the pinholes there in the first place. Far better to make the slide over again if there are blemishes bad enough to require such repairs. In anything but plain opaquing, the *transparency* of the retouching work is what counts, not only in density but in color, and most retouching materials act entirely different when viewed by transmitted light, and overlapping lines show up much worse. The retouching brush should be almost dry, the work should be done over an illuminated groundglass and under a magnifying glass or a loupe. All straight lines should be drawn with a ruling pen against a straight-edge, and it will be found that the colors go on much more smoothly if a drop of a wetting agent such as Wondrop is added to the water in which the brush is dipped. The emulsion will stand much less "worrying" with the brush than the emulsion on a print, due to the magnification in projection.

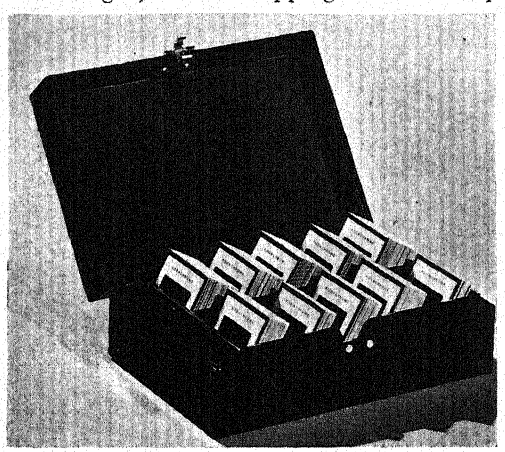


FIG. 12. The Kodaslide Compartment File. This file does not have a separate slot for every glass slide or every 3 Readymounts, but accommodates slides in groups, as shown

FILING AND CARE OF SLIDES

Slides are so much more difficult to identify at a glance than prints that some sort of systematic filing system is almost imperative. There are dozens of handy little slide file cases on the market (Fig. 12), all based on the standard unit 100-pocket drawer. Each pocket will hold one glass-bound slide or three thin Readymounts. An excellent typical example is shown in one of the illustrations—the Bolex 3-drawer 300-pocket cabinet, which holds 300 glass slides or 900 Readymounts (Fig. 13). Each pocket has a number printed alongside it and an index card is supplied with each drawer with corresponding numbers and a line for descriptive matter. In the absence of something of this type, you can even use the empty boxes the slides come in, with pasted partitions each holding a dozen or so, with the index written in the lid. Or else you can use something like the standard 3 x 5 card file box or cabinet, with a ½ inch wooden partition down the middle and cardboard partitions at 50-slide intervals. The indexing system may be simple or complex depending on your flair for bookkeeping, but the minimum system should be a grouping by subject, and the maximum a complete listing with cross-indexing where necessary. It goes without saying that slides should always be kept in the same order and in the correct facing position. Slides that are used consecutively

in lectures, etc., frequently have a line drawn diagonally across the top of the stack (different colors for different subjects) with colored lacquer or some other material, so that when the stack is assembled or filed, any out-of-place slides can be instantly detected and easily rearranged (see article on *Filing For The Amateur*).



FIG. 13. The Albert Thermo-Sealer and plastic-treated masks is at the left, while at the right is a Bolex slide file with a capacity of 300 glass slides or 900 Readymounts

PROJECTION

Since the subject of projection and equipment (Fig. 14) is well covered in other sections of this work a few words here on the matter will suffice (see *Projection* article).

As to the screen or projection surface, a plain wall, white window shade, or sheet will of course serve the purpose in a way, but if you are going to a lot of trouble and expense to make good slides, this is poor economy, as you will find when you see your slides first projected on a good screen after being used to seeing them on a wall, especially if the wall is a little off-white or ivory. Any tint in your projection surface adds just that amount of color to every tone in a Kodachrome, or the equivalent of that much density to a black and white. In a print, this would be the same thing as a *uniform fog* or an over-all color cast in a color print. This simplified explanation should show you the value of a good screen.

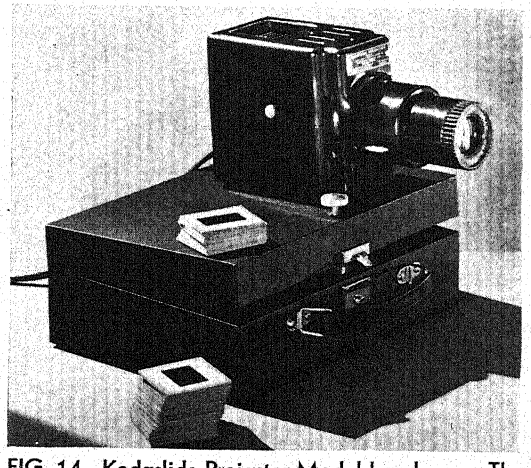


FIG. 14. Kodaslide Projector Model I and case. The tilt top arrangement makes adjustment of height and angle easy

Screens are generally classified in three types of surfaces—aluminum, beaded, and matte. The proper choice depends on room size and viewing angle, and cost. Aluminum-painted screens have a more or less specular effect, giving great brilliance, but only at a very narrow angle, and are therefore best suited only for long throws where the audience is close to the center line. Beaded screens strike a balance between the specular and the matte surface characteristics, while the matte screens are best for short throws where a portion of the audience sits considerably to one side or the other. These screens are all used where both the projector and the audience are positioned in front of the screen.

In certain applications the projector is placed behind the screen, particularly in advertising display uses. The best screen for such purposes is groundglass, but due to its fragility other types of material are often used, such as loose-woven cloth coated with gelatin or other substances, or matte celluloid. For temporary purposes, even plain cloth saturated with water may be used. The only requirement of a back-projection screen is that it shall be matte enough to prevent the hot-spot of the projector lens from showing through, yet no so matte as to lose too much light or produce too much diffusion.

In projecting black and whites or toned pictures, the color temperature of the light source is of little importance, but Kodachromes are another matter. The color temperature of the projection bulb should be the same as that by which the picture was originally taken if true color reproduction is to be secured. For truest color, outdoor Kodachromes should be projected with the highest-temperature short-life bulbs or arcs —Type A Kodachromes with the 3200K longer-life Mazda bulbs. As in taking pictures, correction filters may be used in projection to alter the character of the light to produce correct color balance. If particularly valuable slides are off-color, they can be corrected automatically by binding a gelatin correction filter of the proper strength directly with the slide. Since "true color" is not an exact science, but rather a question of pleasing the eye, expensive filter material is not necessary—very good results may be secured by experimenting with the paler shades of cellophane or theatrical gelatin, singly or in combination. For the amateur who does not want to go to the trouble of projection each time, there are also hand viewers of various types (Fig. 15).

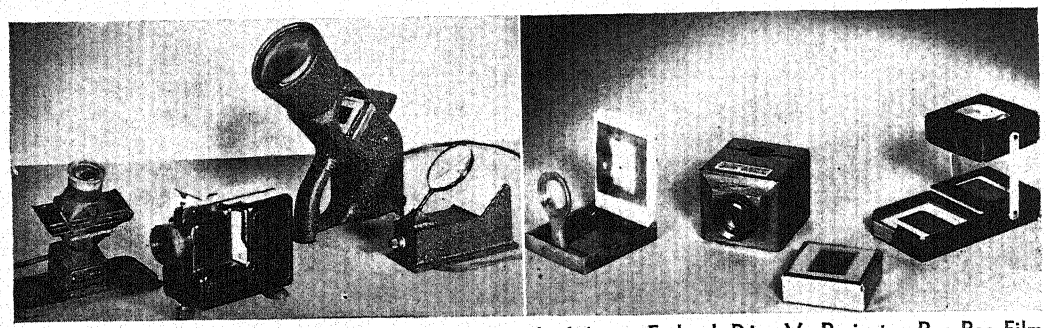


FIG. 15. The illuminated magnifying viewers shown at the left are: Federal, Price Vu-Projector, Bee Bee Film Slide Viewer, Willoughby Chromascope. At the right are hand viewers: Da-Scope, Chromat-O-Scope, Gem-Bolex Mirro-Lite, Gemlite Pocket Magazine Viewer

SLIDES IN COLOR

Aside from the range of colors produced by variations in developer and development technic, every method by which color may be added to positive prints may also be used on slides and transparencies, with certain modifications. Among these are tinting, chemical toning, combination tinting-toning, hand coloring, dye toning, dye-coupled development, and all of the "natural color" processes except possibly carbro, which is little used for this purpose. Another coloring method, not applicable to prints, is the slide-binding system mentioned just above.

Tinting. This consists of impregnating the gelatin with dye, a simple process which consists only of soaking the plate or film in the dye, rinsing, and drying. Any of the prepared photographic dyes or "tints" may be used, or Wash-Off Relief dyes, household dyes of the type used to dye silk and wool, or if you buy raw dyes, get the "acid" or "photo" type. A particularly handy type is the Tabloid Soloid line, which consists of little tablets containing all the necessary ingredients, accompanied by directions. Concentration is not especially important, longer dyeing time causing more dye to be absorbed. The amount of dye taken up by the gelatin is governed by concentration and by the pH of the dye solution. A little alkali (carbonate or ammonia) or momentary immersion in any developer will discharge the dye if it is too strong, or a little 5% acetic acid in the dye solution will cause the gelatin to absorb and hold more dye. If only a little lightening is desired, a soak or wash in plain tap water will bleed the dye out slowly. Slides that are to be stained should not be hardened, but fixed in plain hypo.

Chemical Toning. Tinting, described just above, is a dye process, staining only the highlights and middle tones, and not affecting the color of the image which remains in its original state. Chemical toning, on the other hand, alters the color of the silver image itself by chemically changing it from black metallic silver into some other compound of another color, leaving the high-

lights unaltered. In many cases, the processes are used simultaneously, the highlights being stained or dyed one color, while the image is toned another color, the result often producing a bewilderingly rich mixture of colors if the subject is properly chosen.

The procedure is identical with that followed in print toning (see article on *Toning*), with certain exceptions. The only noticeable difference in technic is the fact that slides must as a rule have greater relative density in the shadows than prints, and occasionally it will be found that blues, greens, and light colors generally may be weak in the shadows, and in order to get around this it may be necessary to resort to "partial toning," i.e., to pull the slide out of the bleach before the deepest shadows are bleached out, so that some black unaltered silver will remain to bolster up the color. This is not often necessary, however, as the color is produced by an opaque pigment-like metallic salt, and not by a transparent dye. Moreover, most bleach-and-redevelop processes have an intensifying action anyway, which also serves to offset the inherent weakness of color.

A few simple cautions must be observed. Developer must be fresh and development complete—contact emulsions for at least 45 seconds, bromides for at least 2 minutes. Hypo must be fresh, preferably non-hardening. Fixing must be thorough, and washing doubly thorough, if there is such a thing.

Among the published formulas for chemical toning which are specially suited to lantern slides are:

Uranium toner (browns to red): Eastman T-9

Sulfide toner (sepia): Eastman T-10

Iron toner (blue): Eastman T-11

IRON-VANADIUM TONER (Green)

Ferric chloride	30 grains
Oxalic acid (saturated solution)	4 oz.
Vanadium chloride	60 grains
Nitric acid	3 drams
Potassium ferricyanide	30 grains
Water to make	32 oz.

Tones in 1 or 2 minutes, the longer the lighter. Wash until highlights clear, then fix in acid hypo, then wash until green color returns. Shade may be altered by increasing amount of ferricyanide up to 10 times the above amount.

Burroughs & Wellcome "Tabloid Toners" are easy for those who do not like to mix their own. A complete range of colors and a very good instruction booklet can be obtained at most dealers and the chemicals are already mixed and come in tablets which merely need to be dissolved in water.

Dye-Coupled Development. This is a process wherein a transparent dye is deposited simultaneously with the reduced silver image during development. The developers are rather tricky to compound, and the dyes difficult to obtain, so the best method is to buy the ready-made product, examples of which are Gem Kolorchrome, F-R Develochrome, and the Mansfield. In making paper prints with this method it is customary subsequently to bleach out the black silver image, leaving only the mordanted dye image. Tests will show whether this is necessary or advisable with your slides, as some of the deeper shadow densities may need to be retained by not bleaching or by only partially bleaching. These same developers may also be used to dye-tone black and white MQ-developed slides, by first bleaching as per directions supplied with the color developers. With these color-developed slides also, it is possible to secure interesting effects with the right slides by staining the highlights with dyes, partially or entirely.

Dye Toning. This is a chemical process that converts the silver image into a mordant or "magnet" which will attract and hold certain *basic* dyes, the dyes remaining in the slide only in those portions where the presence of the silver has caused the mordant to be formed, and in direct proportion to the amount of silver present. Some mordanting baths leave a little opacity in the image which interferes with good projection qualities, but the following (*American Annual of Photography*, 1929) gives a clear image:

Copper sulfate	1 oz. 145 grains
Potassium citrate	8 oz. 165 grains
Glacial acetic	1 fl. oz.
Ammonium thiocyanate	365 grains
Water to make	32 oz.

424 grains of potassium thiocyanate may be used instead of the ammonium. The thiocyanate should be dissolved separately and added to the solution last.

The slide is bleached in the above, then immersed in the desired dye solution, which consists of 3 grains of any of the following dyes, with 1¼ drams of 10% acetic acid in 32 ounces water:

Safranine A	Red
Chrysoidine 3R	Orange
Auramine	Yellow
Victoria Green	Green
Methylene Blue BB	Blue
*Methyl Violet	Violet

* Use only one-fourth the above quantity of Methyl Violet.

Small quantities of these dyes can be obtained from Eastman through your dealer or direct.

Time of dyeing ranges from 2 to 15 minutes, and if the slide does not absorb sufficient dye in that length of time, wash thoroughly and re-mordant, wash, and dye again. Color may be reduced by a weak alkali solution (a few drops of ammonia in water). The dyes may be mixed to obtain intermediate tones, or the slide immersed in successive colors, or color may be applied locally with a brush to obtain multi-color effects, or simple masking may be employed, using dilute rubber cement.

KODACHROME

This is the ideal material for slide making, and is responsible more than anything else for the great revival of public interest in slide-making and projection. The true color reproduction, practically grainless character of the image, the ease with which full-color reproductions and duplications may be made, and the comparative cheapness of the material are its main features.

The technic of making original Kodachrome transparencies is too well covered elsewhere to require expounding here (see page 855), but a brief outline of the various methods of producing duplicates, enlargements, and reductions might be of help. If more than one slide of a certain subject is wanted, the simplest method, of course, is to make a number of exposures in the camera in the first instance, if this is possible. However, since the decision to make duplicates is seldom made until after the original is processed and returned, this is seldom done. Eastman makes two types of duplicates, Type "U" is a plain unmasked print, with the colors very slighly degraded, suitable for most practical purposes. Type "M" duplicates are masked, and provide practically perfect color duplication, and cost a little more. If you want to enlarge or reduce, correct a mean color-cast or make any other changes, expose them yourself by projection or in the camera and send the film to Rochester for processing.

When using the enlarger, the cut-sheet film is the easiest to use, and it is exposed like any other cut-sheet film, in total darkness, with lights of the proper temperature to suit the type of Kodachrome being used. Notches as usual are in the upper right hand corner when the emulsion is facing you. The film may be sent off for processing either one at a time or the full box. It usually pays to send first a test exposure and then you are guided by this on subsequent exposures. Some type of enlarging meter is almost a necessity for purposes of establishing a standard for comparison. Make a record of your highlight and shadow reading on your test exposure, as well as the lens setting and the lens-to-film distance, and subsequent exposures may be calculated mathematically from this data, with corrections based on the results shown by the processed test exposure.

Slides from 16mm Kodachrome. Enlarging single frames of 16mm Kodachrome movies is an ideal method of getting beautiful slide material. The process itself is quite simple, and the great advantage is that you can pick any one scene and find three or four hundred different treatments of it, selecting the one which has just the exact composition, position, and lighting of principals and background that would make the best slide. The degree of enlargement from 16mm to 35mm, or even to 2¼ x 3¼ for a 3¼ x 4¼ slide, is not beyond the capacity of the average enlarger, nor so great as to bring out the mushiness apparent in large blow-ups from 16mm. The same remarks apply likewise to 16mm black and white material.

Eastman also makes enlargements to the size desired (except from 16mm) and it is often quicker and cheaper to send the work off instead of doing it yourself. But they do not do any dodging, masking, or color correction.

LARGE DISPLAY TRANSPARENCIES

These are highly effective when done in color, and any of the common color processes may be used, with adaptations necessary due

to the fact that the picture is viewed by transmitted light.

Hand Coloring. Transparencies may be hand-colored in the same manner as prints, except that the colors must be applied by transmitted light in order to judge the effect properly. It will soon be seen that three or four times as much color must be applied as for prints, and the strength and color of the light used when applying the color must be the same as the light which is to be used for final mounting and viewing. Dyes will be found easier to handle than pigments, as too much pigment will show up as opaque and brush strokes will show up, whereas dyes blend more smoothly and are always transparent. Color may be applied to either the back or front, or both, and interesting display effects may be secured by applying the color only to the back and using a flasher, so that the picture is alternately black and white and colored, or by applying different colors to the front and back. If the differences and blendings are subtle, the picture will almost seem to pulse with life as the illumination switches from front-lighting to back-lighting. Color may also be used on the light source, with or without a flasher, or combinations of colors, front and back, producing a variety of effects (see also *Flexichrome* article).

WASH-OFF RELIEF TRANSPARENCIES

The technic of making Wash-Off Relief transparencies is the same as that employed in making imbibition prints, except that the dyed reliefs themselves are bound together to form the transparency. The contrast of the separation negatives employed for this purpose must be much greater than those intended for imbibition prints, and the strength of the acetic acid rinsing and setting bath should be about 5 times as great, i.e., where a 1/10% bath is used for rinsing and setting the colors for imbibition printing, a ½% bath is used for transparencies. The matrices have a sort of matte surface, which usually provides ample diffusion, but if the light source is too apparent after binding the three together, it may be necessary either to bind a sheet of matte celluloid with the three reliefs, or else to varnish one or more of them with matte varnish.

GEORGE R. LAWRENCE

H. H. Slawson
Free Lance Writer

Lawrence, an American photographer, was well known during the first part of this century, for his work with large cameras, flashlight exposures, and aerial photography. Here is an account of his life.

See Also Kite and Balloon Photography

GEORGE R. LAWRENCE: Pioneer photographer-inventor. Born at Ottawa, Ill., Feb. 24, 1868; died at Chicago, Dec. 15, 1938.

George R. Lawrence, at the height of his photographic career, enjoyed world-wide fame and received distinguished honors for pioneering achievements which marked photographic progress.

His introduction to photography was due to chance. Raised on an Illinois corn belt farm and with only a country school education, he found employment, when twenty years old, in a Chicago wagon factory. Discovering an ability to make crayon enlargements from cabinet photographs, he opened a studio to produce these parlor wall decorations of the "gay 90's." When a photographer to whom he subleased space suddenly decamped, Lawrence, in 1893, became owner of a camera and other photographic equipment. Two experimental "sittings" were immediately made and his competitor's apprentice was persuaded to teach him plate development. Whatever else Lawrence thereafter learned about photography he taught himself.

Four outstanding achievements mark his ensuing career.

(1) He invented a flashlight powder and method for utilizing it which were in standard use until superseded by flashbulbs.

(2) He built the world's largest contemporary camera, a size possibly still unrivaled.

(3) He devised a means for making aerial photographs at heights up to 2,000 feet when airplanes were non-existent.

(4) He obtained, with aerial cameras, pictures of African jungle life hitherto unknown.

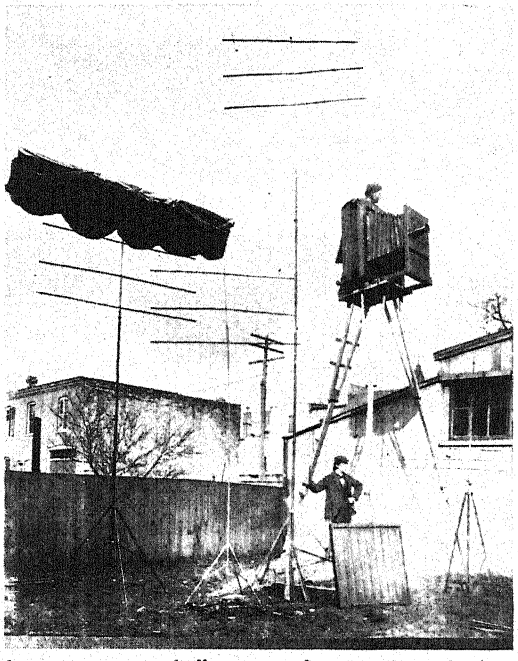
FLASH POWDER

Invention of the flashlight powder earned Lawrence recognition as "The Father of

Flashlight Photography," while associates dubbed him "Flashlight Lawrence." Search for the new powder was prompted by the ineffective red light emitted by powder available prior to 1895 and by its limitation largely to studio use. Knowing nothing of chemistry, Lawrence tried and discarded until he hit on a combination of chemicals producing results sought.

The new powder provided a powerful white light but ignited so slowly that a match was ineffective. Ignition was finally contrived by heating the powder from electrical wires embedded in the charge. For its utilization he devised the system of placing it on standards at points around the room, connected by an electrical circuit which exploded all charges simultaneously. At the same instant a canvas bag dropped to trap the smoke.

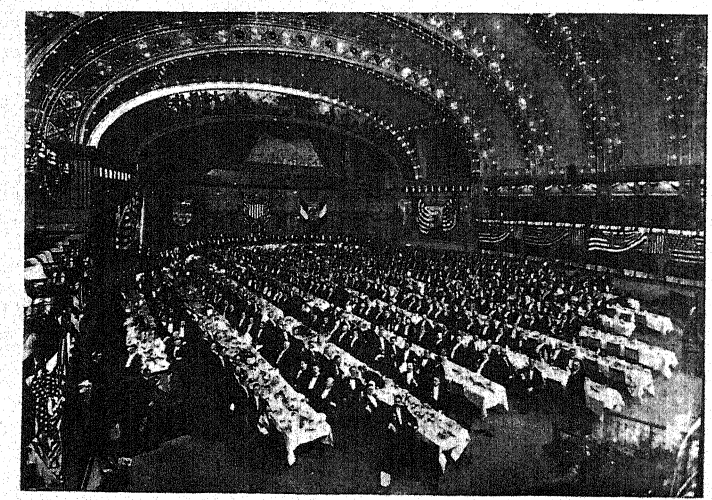
From the old-fashioned gas jet came the idea of forcing the flame through a narrow slit, thus spreading the light in a flat plane to increase its effectiveness. In Chicago's vast Coliseum, Lawrence once made a flashlight photo requiring twenty pounds of old-style powder. Later, with his improved product, he made another picture there which used only five ounces of powder. These figures suggest the progress his invention represented. Because of their potential danger, New York and Chicago police had banned flashlights of large assemblies, but Lawrence's invention lifted this ban and opened the way to the lucrative "banquet business" which photographers have since enjoyed.



Lawrence, in a skull cap, is shown atop a 15-foot tripod with one of his "smaller" cameras. Around him are standards for flashlight powder and one has the canvas smoke trap already attached

WORK WITH LARGE CAMERAS

Construction of the world's largest camera in 1900 resulted from an order for "a perfect contact picture not less than eight feet long" of a new Chicago & Alton railroad train. Lawrence explained that with existing cameras he could only make sectional views of the long train and piece these together. This, officials felt, would never do. With assistance from J. A. Anderson, a local camera builder, Lawrence therefore designed a camera weighing 1,400 pounds and requiring fifteen men to manipulate it. Its bellows extended twenty feet on wheels running upon a steel track. Plate holder size was 10 x 6 feet, making possible pictures 8 x 4½ feet



A famous Lawrence flashlight photograph, taken at a banquet for President McKinley in the Auditorium Theatre, Chicago. Critics commented on the marvelous sharpness of detail

in dimensions, or three times the largest print previously available.

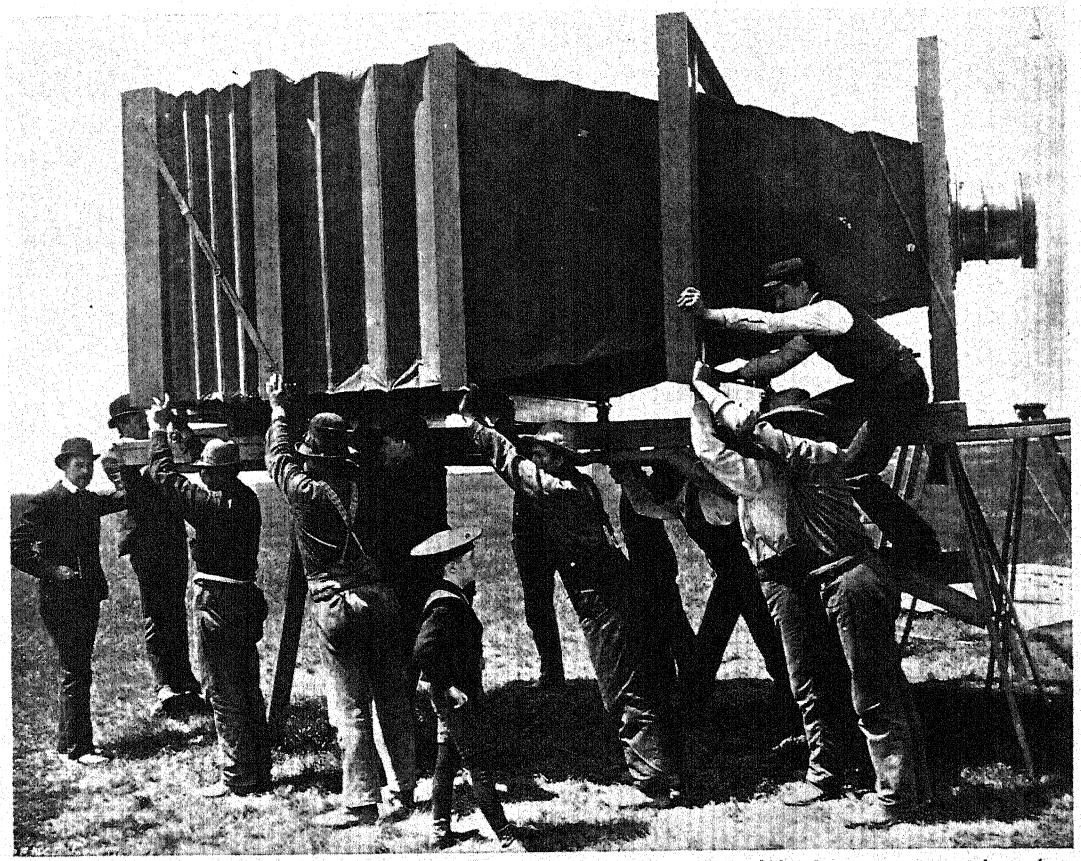
Lenses used were, up to then, the largest ever ground for photographic work, one being a wide-angle affair of 5½ feet equivalent focus, the other a telescopic rectilinear lens of 11 feet equivalent focus. Features included a rising and swinging back and front and it was usable for either upright or horizontal views. For focusing screen a sheet of semi-transparent celluloid was provided and light-proof curtains, resembling window shades protected the negative before and after exposure.

A "door" in the bellows permitted access to the interior where a man with a camel's-hair brush could dust off the plate before exposure. Manufacture of plates and printing paper created problems whose solution, with cooperation from the Cramer Company, St. Louis, extended photography's known limits. New developing and printing methods were also worked out. Plates cost $1,800 per dozen.

The first mammoth picture, when submitted for exhibition at the Paris Exposition of 1900, was branded a fake by art authorities, who questioned the claim that it was made from one negative. This controversy was settled only after the French consul in New York journeyed officially to Chicago to see how Lawrence had contrived the giant. Eventually Lawrence was awarded the Exposition's "Grand Prize of the World" for photographic excellence, this medal becoming the first of many similar future tributes.

AERIAL PHOTOGRAPHY

Lawrence's first attempts at aerial photographs were made from ladders anchored by guy ropes before race track or baseball audiences. Next he devised a 216-foot tower whose sections, manipulated by pulleys and ropes, telescoped inside each



The world's largest camera, constructed by George R. Lawrence in 1900. Weighing 1400 pounds and requiring more than 10 men to manipulate it, the camera made pictures 8 x 4½ feet in size

other. Aspiring still higher, he acquired a captive balloon which he first used on June 21, 1901.

Ascending 950 feet over Chicago's stockyards district, Lawrence made several exposures from the frail cage attached to the gas bag's netting. While descending, the netting ripped, permitting the gas bag to escape and float away. Lawrence was hurtled 228 feet through space, but fifty feet from the ground some telegraph wires broke his fall and he landed without injury.

Obtaining a second balloon, Lawrence eventually got his stockyards picture. Then began a bizarre expedition to make aerial views of Minnesota towns as a circulation-building stunt for the *Minneapolis Tribune*. Caught above a lake in a windstorm, he survived another harrowing experience which convinced him that balloon photography had drawbacks.

Intrigued next by the idea of kites for carrying cameras skyward, he developed a "kite-airship" which was undoubtedly the most unique piece of photographic equipment ever conceived. At each kite's core was a pair of prisms having triangular bases. Between them was an open space, while two top and two lateral edged wings were attached to form a plane surface seven feet in over-all dimensions.

As many as seventeen such kites, having "safety valves" and other features to cope with varying wind conditions, were strung on one cable controlled by a windlass. The camera was suspended below the farthermost kite on the line, with a complicated rigging which maintained perfect equilibrium during exposures. Housing for lens and negative was a simi-circular box. An electrical current operated the shutter and "brakes" were provided to prevent exposures in response to jerks or bumps. The lens, which swung in an arc, was set off-center to catch foreground on three-fourths of the negative and sky on the rest. Seven such aerial cameras, weighing 400 to 1,000 pounds, were constructed to take photographs 8, 4½, 3½, and 2 feet long. Glass plates were first used but later replaced by films.

Demonstrations of this outfit were arranged before United States Army and Navy officials on executive order of President Theodore Roosevelt. They proved that aerial photography was practical, but the offer of the device for national defense purposes was later withdrawn.

San Francisco's earthquake disaster of April 18, 1906 then provided a spectacular subject for this Gargantuan apparatus. Elevating his kites 2,000 feet above the ruined city, Lawrence obtained a 8 x 4½ foot shot which became probably the world's best paying photograph. World-wide sales totalled over $15,000.

Followed then a period of aerial surveying work, a development which historians might contend originated more recently. Big bird's-eye views made above semi-arid areas in Nevada, Utah, Wyoming, and Idaho revealed details of grazing lands, tillable fields, streams, etc., and were used by a real estate promoter in organizing irrigation projects.

AFRICAN EXPLORATION

Engaged in surveying, Lawrence in 1910 was invited to accompany a Chicago publisher on a British East African trip. Through the jungles native porters lugged 28,000 pounds of photographic supplies, including kite outfits, collapsible towers, and two balloons with gas-making equipment. Unfortunate disagreements arising, the expedition prematurely disbanded. Among trophies obtained, however, were flashlight pictures made by animal subjects themselves in series of six at a time, the stunt being contrived by using two cameras each having three lenses. On a plate's upper half two lenses made small stereoscopic pictures, while below these the third lens made one large picture.

To lure a jungle beast within range a dead carcass was properly planted and a cord connected the meat with one camera's shutter. A jackal, devouring the meat, would unwittingly trip this first shutter. This closed an electrical circuit which fired the flash, which burned the cord, which closed the shutter. This final closing movement operated another cord which opened the second camera's shutter. Again this closed an electrical circuit which fired a second flash, which burned the cord to the first camera and closed the second shutter. And the negative caught the animal "coming and going."

Returning to Chicago, Lawrence abandoned photography for industrial efficiency engineering. Becoming interested in aviation, he later devised numerous inventions which contributed to the advance of aeronautics. Still later he turned his fertile mind to the air conditioning field.

In 1936 he returned to photography, opening a studio in partnership with the man who, back in 1893, had taught him how to develop his first photographic plates. Advancing age and ill health, however, forced him to step out and his death occurred on Dec. 15, 1938.

LEGAL ASPECTS OF PHOTOGRAPHY

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No photographer can afford to be ignorant of the laws which govern his special photographic activities and presented here is a vital and exhaustive study of the law of photography—for the professional and amateur. It is written by a doctor of jurisprudence who has taken part in many important trials involving photography. The subjects included are libel, right of privacy, photographs as evidence, laws governing subject matter, ownership of print and negative, transportation, etc.

See Also Copyright

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XI. COPYRIGHT (see page 1085)

I INTRODUCTION

Section 1. Scope Note. Insofar as law is concerned, the United States is much less a compact union than the layman suspects. Each of the forty-eight States has its legislative bodies, and each has its own courts to interpret the meaning of its law. Except where a statute contravenes the United States Constitution, each State has the right to decide for itself what its laws shall be, and as a result, one finds what is legal in one jurisdiction may be illegal in another, and what may be prohibited in one State may be perfectly proper procedure elsewhere.

No treatise, therefore, which attempts to inform the photographer as to the law covering his profession or hobby can possibly be completely accurate, for this can only be done if forty-eight separate articles were written. The reader, therefore, is cautioned that what follows is primarily a statement of general principles and the raising of general questions which may prove a valuable guide to him, regardless of the State in which he lives. If the reader is faced with a photo-legal problem of importance, he would do well to consult an attorney within his own State borders to establish exactly what the rulings in his jurisdiction have been.

This treatise has attempted to cover as many of the States as possible within these space limitations. Special stress has been placed upon the laws of the State of New York, which by and large appear to be followed by a majority of the other States.

It must also be borne in mind by the reader that the photographer is an individual, subject to the same laws which govern men in other professions or in other hobbies. All laws obviously apply equally to the photographer. This article treats primarily with those statutes and with those legal decisions which have particular interest or direct relevancy to photography, even where the field of law involved is of general applicability.

II THE PHOTOGRAPHER

Section 2. Definition. It is generally accepted that the photographer is an artist, not a mechanic. The problem arose in two States in entirely different manners. In Louisiana, a certain tax was imposed, but the State Constitution had specifically exempted all persons engaged in mechanical pursuits from the payment of such taxes. The question was raised, therefore, whether or not the photographer was a mechanic who might claim such exemption.

The court[1] stated, "Certainly in both painters and photographers, the hand and the sense of sight are controlled by an unusual exertion of a superior intellect which, to direct and accomplish properly, must be distinguished and actuated by rare knowledge, ability and practice not found in or acquired by first comers . . . It strikes common sense that the defendant is not an automaton but one who, practising a science or a liberal art, is a scientist or an artist although of an inferior grade." Therefore, the Court concluded, the photographer could not claim the mechanic's exemption.

In New York, the question came up whether or not a photographic studio need comply with factory regulations. The court[2] stated, "We are of the opinion that ordinary photography, as here described, may not be said to be manufacturing. We may take judicial notice that it is merely the production, by the chemical action of light, of objects upon a film, imposed upon glass, metal, celluloid or other suitable material, and the reproduction of such objects by

[1] City of New Orleans vs. Robira (1890) 42 La. Ann. 1093.

[2] People vs. Cross and Brown Co. (1931) 232 A.D. 587, 251 N.Y. 138.

further light action by means of the negative placed between the light and paper, or other substance, also sensitized to the chemical action of light. Such process is in no way the making or manufacturing . . ."

It is highly significant to note that in this case the regulations being examined affected factories having six or more employees, which was not the situation with the photographic studio involved. The court could well have based its decision solely upon that one fact, stating that it did not apply to the studio because of the number of employees. Nevertheless the Court took the pains to distinguish between photography and manufacturing. It may well be, therefore, that the decision will be followed even with a large photographic studio or finishing laboratory having the requisite number of employees.

Section 3. Licenses. The license problem is one of particular interest to all photographers, especially to the amateur who finds his activity somewhat curtailed because of local ordinances or State regulations which may apply to him when he infrequently sells a print. On the whole, it may be safely said that whatever licensing provisions there are apply only to the professional photographer and do not cover the man who finds an occasional opportunity of obtaining some money for one of his pictures. Since the widespread organization of amateurs through

LICENSING STATUTES

	No Licensing Provision	*Licensing For Fee Only*	*Licensing By Examiners*
Alabama		X (a)	
Arizona	X (b)		
Arkansas		X (c)	
California	X		
Colorado	X		
Connecticut	X		
Delaware		X (a)	
Florida			X (a) (d)
Georgia		X (a)	X (e)
Idaho	X		
Illinois	X		
Indiana	X		
Iowa	X		
Kansas	X	(f)	
Kentucky	X		
Louisiana		X	
Maine	X		
Maryland	X		
Massachusetts	X		
Michigan	X		
Minnesota	X		
Mississippi		X (a)	
Missouri		X (a)	
Montana			X (a)
Nebraska	X		
Nevada	X		
New Hampshire	X		
New Jersey	X		
New Mexico	X		
New York	X		
North Carolina		X (a)	
North Dakota			X (a)
Ohio	X (g)		
Oklahoma	X	(f)	
Oregon	X		
Pennsylvania	X		
Rhode Island	X		
South Carolina	X		
South Dakota	X		
Tennessee	X		(h)
Texas	X		
Utah	X	(f)	
Vermont			X (a)
Virginia		X (i)	
Washington	X		
West Virginia	X		
Wisconsin	X		
Wyoming	X (g)		

Notes on chart of Licensing Statutes at right:

(a) Statute so worded as to apply to professional photographers only.

(b) Act of 1935 was declared unconstitutional by the Arizona Supreme Court.

(c) Applies only to itinerant photographers. Applicant for license must file surety company bond in the sum of $500 for the faithful performance of all contracts entered into by the licensee.

(d) Statute so broadly worded that it might even be construed to include an amateur who occasionally takes pictures for hire.

(e) 1937 Statute set up a State Board of Photographic Examiners but was declared unconstitutional. Bramley vs. State, (1939) 187 Ga. 826, 2 S.E. (2d) 647.

(f) Although no State license is required, Statute expressly provides that cities shall have the power to pass ordinances requiring license for regulation or revenue.

(g) Bill introduced in 1940 failed to pass.

(h) Chapter 253, Public Acts of 1937, created a Board of Photographic Examiners, but the act was held unconstitutional in Wright vs. Wiles (1938) 173 Tenn. 334, 117 S.W. (2d) 736.

(i) Virginia also has Statute regulating practice of photography. See Act of 1938, 544.

clubs, councils and associations, fewer licensing provisions have been passed, because the organized strength of the amateurs successfully prevented the passage of such legislation in many instances.

It is imperative for the photographer to remember that many cities and towns have local regulations which may affect the solicitation of business or the sale of prints. These must therefore be ascertained locally by the photographer. The chart on page 2223 will be of help in learning the situation in any particular State.

III WHERE THE PHOTOGRAPH IS TAKEN

Section 4. The Studio. Generally speaking, the photographic studio or photo-finishing laboratory is a place of business and subject to the same regulations which affect other industries, despite the fact that the photographer himself was not considered a manufacturer[3].

In Minnesota, a test case[4] was made by a photographer who kept his studio open on Sunday for the purpose of taking some pictures. He maintained that this endeavor in no way interfered with the repose of the community or its religious liberty, for the protection of which the Sunday Statutes had been enacted. He contended also that his was artistic activity and not physical work. The Court ruled, however, that although the community had not been disturbed in the least, nevertheless the common good required the observance of the Sunday Statutes in all fields. The decision is important as an indication that in general, professional photography will be treated purely as a business and not as an artistic exploit.

Section 5. Negligence In the Studio. It is not surprising, therefore, that the general rules of negligence should apply to photographic studios, which must be maintained just as safely as any other business establishment. By no stretch of imagination can the photographer be exempt from providing reasonably safe quarters for business invitees.

Where, for instance, an infant eight months old fell from the table on which he was being photographed and was severely burned by coming into contact with exposed steam pipes immediately adjacent to the table, the Court ruled that such injuries as the child sustained should be compensated.[5] The decision stated that "the owner and tenant cooperated in creating a condition which any reasonable, prudent person must have known could cause injury. The anticipated use of the room, its ineffective lighting, the harmless appearance of the pipe, its potential capacity to severely burn, if contacted when full of steam, the possibility that young children would be present in the room and come in contact with the pipe, were matters which a reasonable, prudent person would have considered. . ."

Similarly, the stairways and passageways to a studio must be constructed and maintained so as not to precipitate danger to one using them to gain access to or exit from a photographer's studio.[6]

Section 6. The Street. The photographer has the right, generally, to take any pictures on the byways and highways of the city or country. He must, of course, beware of possible local ordinances which may have been passed by a particular village council or the like, which limit this right in certain cases. Obviously enough, it is impossible to cover here the innumerable communities which may have passed such local regulations.

The photographer must clearly distinguish between his right to take a picture in the street of anything or anybody he sees there, and his right to use that picture, which is an entirely different problem. The restrictions upon his right to use the picture are discussed fully below in its many ramifications.

Individuals have, from time to time, questioned by actual physical assault the right of a photographer to take pictures in public places; such assaults have since time began entailed both civil and criminal liability.

(*Continued on page 2225*)

[3] People vs. Cross and Brown Co., see footnote 1 supra.

[4] State vs. Dean (1921) 149 Minn. 410, 184 N.W. 275.

[5] R.K.O. Midwest Corp. vs. Berling (1935) 51 Ohio App. 85, 199 N.E. 604.

[6] In Boyd vs. Gardner (1940) 62 Ga. App. 662, 9 S.E. (2d) 202, an elderly woman fell because of a step in the passageway leading from the lobby to the dressing rooms in the studio which was not illuminated. The court held that this condition was unsafe and held that the matter was actionable.

LEGAL ASPECTS OF PHOTOGRAPHY

(continued)

But in 1939 New York State went even further than the early common law on the subject by adding a statute designed to protect even the apparatus and equipment of the news photographer. This law[7] declares that one who wilfully injures such apparatus is guilty of assault. Bodily attack upon the person of the photographer is no longer material.

Section 7. The Court Room. Many photographers, both amateurs and professional, have at various times undertaken to shoot pictures in a court room. Ordinarily, such a locale in itself does not prevent the taking of pictures therein.[8] It is not to be questioned, however, that the presiding judge has the right to establish whatever rules he deems advisable as to the taking of photographs in his courtroom. He may, if he so decides, prohibit such pictures in order to prevent the exploitation of a person's likeness against his will, and avoid undue disturbance in the court.

Where a judge did specifically prohibit the taking of pictures in his courtroom in connection with an important murder trial, a photographer refused to turn over to him a plate which had been exposed prior to the order. Another photographer used a small camera surreptitiously after the order, and both men were cited for contempt.[9] In upholding the citation of both the photographers for contempt, the Court, among other reasons, stated "The liberty of the press does not include the privilege of taking advantage of the incarceration of a person accused of crime to photograph his face against his will." It appears, however, that the primary reason of the citation was the refusal to obey the Court's order, rather than the photography of a prisoner.

Section 8. Places of Amusement. No American statute or case seems to prevent the photographer from bringing his camera into any place of amusement, whether it be a theater, football field, or any other arena of entertainment.

The question did arise in England, however, where it was ruled that any restriction might be imposed by the operator of any place of amusement, which, in that case, involved a dog show. Such restriction, however, must be made a part of the contract at the time the ticket is sold. This case will probably be followed in the United States if the question should arise, but one must also bear in mind the very common provision which appears on a ticket, which authorizes the management to refund the price of the ticket and prevent admission to any one in the exercise of its sole discretion. Where such a clause appears on the ticket, a photographer could be prevented from entering with his camera if the management so desires.

If one has taken a picture in such a place of amusement, his right to use that picture is of course governed by the further question of whether or not the subject's right of privacy is involved, and that is discussed fully in Article IX A, infra, page 2233.



There is a great distinction between the right to take a picture and the right to use it—especially to publish it. There is nothing to prevent you from photographing this pretty girl on the street, but you should have her explicit written consent before you try to publish it, unless the picture is published in a newspaper in connection with a news article

[7] N.Y. State Penal Law, Section 244.
[8] In re Seed (1931) 140 Misc. 681, 251 N.Y.S. 615.
[9] Ex Parte Sturm (1927) 152 Md. 114, 136 Atl. 312.



Some museums permit the use of a camera and others do not and it is best to find out the rules for each individual place beforehand. In the Smithsonian Institution in Washington, for instance, pictures may be taken except in the corner where statues of the wives of former Presidents are exhibited

Section 9. Museums. Whether or not a photographer may take pictures in museums is purely a matter of individual regulation. Some museums prohibit the use of cameras; others allow them but merely restrict the use of tripods. Others do not allow flashlights to be used. One must therefore ascertain the rules in a particular museum before using his camera therein.

IV SUBJECT MATTER

Section 10. Money, etc. The Federal Government, in its efforts to wipe out possible counterfeiting, prohibits the photographing of money and securities.[10] Although the statute makes the mere act of photographing money or securities a crime, it is believed that a photographer would not actually be convicted for this violation unless he intended to pass off the photograph as actual money or securities.

It is similarly illegal to photograph certificates of indebtedness, bonds, bank notes, and in short, any monetary instrument of the United States, including even a check signed by an authorized officer of the United States.[11] As a reciprocal gesture with other countries, it is also unlawful to photograph the currency of most foreign nations.

Coins may be photographed so long as there is no illegal motive involved. Obviously, it would be impossible to pass off a picture as a coin, which explains the privilege given to metal currency.

Section 11. Postage Stamps. The Post Office Department prohibits the photography of stamps, either domestic or foreign, unless some indication be placed upon the photograph or its reproduction so that the photograph or reproduction could not possibly be mistaken for an actual stamp.

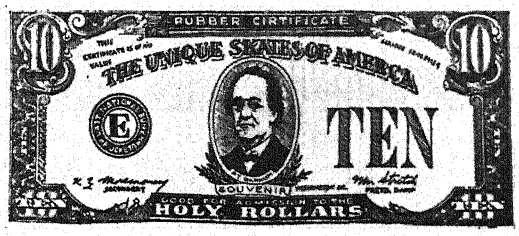
As far as American stamps are concerned, this can be done merely by making the photograph or reproduction less than three-quarters or more than one and one half the linear dimensions of each part of the stamp. The change in size is sufficient to show Americans that it is not a real stamp. Since Americans, however, are not supposed to be as familiar with the size of foreign stamps, such dimensional alteration is insufficient where foreign stamps are concerned. With them some mutilation is necessary, such as a line drawn across the face of the picture. Such mutilation is also permitted in a photograph or reproduction of American stamps, if for some reason the user desires to retain the actual size.

Section 12. Securities. Most states have penal statutes preventing the photography of stocks, bonds and other securities as well as all instruments for the payment of money. Such regulations are usually found in penal laws under forgery.[12]

[10] 18 U.S.C.A., Section 264.

[11] Ibid.

[12] See N.Y. State Penal Law, Section 887.



United States money may not be photographed. There are also restrictions on the photography of postage stamps. See *Coin Photography* and *Philatelic Photography*

Section 13. Miscellaneous. Citizenship certificates are also prohibited subjects for photography.[13] Bills of lading are likewise photographically restricted inasmuch as they might too easily be offered as genuine bills of lading and if one knowingly, with intent to defraud, photographs any bill of lading purporting to represent goods, such action is a misdemeanor.[14] Because of the absence of intent to defraud, photostats made for legitimate purposes are perfectly proper.

Section 14. People. There is no restriction of any kind which prevents the photographer from taking a picture of any individual. There is an absolute dearth of legal opinion on the subject, but the very absence of any statute or cases would indicate that this right exists. Whether a court may at some future time limit this right is purely conjectural.

Once again the reader must be cautioned to make distinction between the right to take a picture and the right to use that picture. Unless he commits a nuisance or interferes with another when taking the picture, however, he may do so without restriction. The use of the picture involves the right of privacy discussed in Article IX A infra (page 2233), and may also involve a question of libel, if at all improper, as discussed in Article IX B infra (page 2239).

Section 15. Naval and Military Objects. In the interests of national defense, the President has the right to declare that certain vital military and naval installations or equipment require protection against the general dissemination of information relative thereto. Upon such declaration, it is unlawful to make any photograph of such matters without first obtaining the permission of the proper authorities and promptly submitting to such authorities a finished picture for censorship or for such other action as may be deemed necessary.[15] The mere point of view, or the distance from the subject, is not enough to nullify this provision.[16] Within thirty days from the date on which the President makes such declaration, no person can reproduce, publish or give away any photograph of such subject without obtaining this permission and even then the photograph must clearly indicate that it has been properly censored.[17]

During national emergency the privilege of photographers is further limited. These restrictions increase almost daily, and only recently the Department of Docks of New York City issued an edict excluding photographers from the City's waterfront. The Department of Public Works also banned the photography of bridges. It must be remembered by the photographer that all bridges which span navigable waters are under the jurisdiction of the War Department, and are subject to its regulations, as well as to those of local authority.

In June 1941, a cabin cruiser sailed by the Brooklyn Navy Yard and the people on board were observed using cameras. The Marine Police quickly overtook the boat and the passengers were brought in for questioning. After it was determined that they were innocent, well-meaning Americans, they were released, but the cameras were held until the films were developed and the negatives were then destroyed. Even New York City ferry boats now have formal notices posted which make their decks forbidden territory for the photographer.

These emergency regulations have been duplicated throughout the entire country since the declaration of war in December of 1941. Practically all factories, power plants and water supply systems have been placed beyond the reach of the photographer. It must be remembered that these restrictions are temporary expedients which will undoubtedly be revoked when the conflict is terminated.

Even in the absence of a posted notice that a camera is not to be used, one should be extremely conservative in judgment and avoid the slightest tinge of suspicion. A photographer should meticulously shun any subject matter which might be of possible value to the enemy, into whose hands any picture might theoretically fall.

V THE NEGATIVE

Section 16. Who Owns the Negative? Although the photographer who takes a picture

[13] 18 U.S.C.A., Section 137.
[14] 49 U.S.C.A. Par. 121.
[15] 50 U.S.C.A. Section 45.
[16] 50 U.S.C.A. Section 45 a.
[17] 50 U.S.C.A. Section 45 b.

is the nominal owner of the negative, it may be said generally that he has no right to use it for his own purposes, but only for the specific purpose for which he was employed to make the photograph. This rule applies only to the professional photographer and is based upon the theory of contract which exists between him and his employer.

Even before the advent of the doctrine of the right of privacy discussed below, an English case[18] held that a photographer could be enjoined from selling copies of a lady's portrait, since the implied contract was that he had been hired only to make copies of the picture for her. This theory of implied contract has been followed in this country, and the photographer who takes pictures of a paying customer has been prevented from using the negatives to make other copies for other purposes.[19] The Federal Court said plainly, "The negative may belong to the photographer, but the right to print additional copies is the right of the customer."[20]

Even where a photographer was engaged to take a picture of the dead body of a malformed child, the father was able to recover damages when the photographer sought later to sell additional prints to other people without the father's consent.[21]

VI *PROCESSING*

Section 17. Loss During Processing. Many cases have arisen involving the loss of either a negative during processing or a picture while being copied. There is no question but that the loss or damage to the negative or picture is actionable, and the problem presented is only to ascertain the true measure of damages.

While the mere sentimental value of a photograph is not to be considered in awarding damages for its loss or destruction, the difficulties of replacement may be given weight by a court or jury. The best discussion of the law appeared in a New York case,[22] where the plaintiff's baggage was lost and some negatives which he had exposed on a trip were in the missing trunk. The Court affirmed the jury's award, the amount of which is not reported, stating "that these articles had no market value was quite clearly shown, and, when that appeared, the plaintiff was at liberty to give such other evidence as would assist the jury to assess the actual value. That was to be done by showing . . . the cost of obtaining the photographs, the purposes for which they were procured, and the difficulty of replacing them . . . The fact that the negatives were not good ones, and were not well taken, was, of course, to be considered; but, in addition to that, the jury might also consider that when one has gone a long way to obtain photographs of the scenery of a foreign land, which is difficult to reach, or where the photograph is of some incident which is not likely to be repeated, even a poor representation may be of considerable value, if a picture can be printed from it, because, as far as it goes, it is a correct representation of what occurred. All of these points were to be considered by the jury. We cannot say that the amount of the verdict which they rendered was improper."

Many cases on record applying to personal effects lost or destroyed might well apply to photographs. Where a warehouse lost certain property of a plaintiff, the Court[23] stated, "The amount of the recovery ought not to be restricted to the price which could be realized by a sale in the market. The owner should be allowed to recover the value to him based on his actual money loss, all the circumstances and conditions considered, resulting from his being deprived of the property, not including, however, any sentimental or fanciful value, he may for any reason place upon it."[24]

As late as 1939, however, a Municipal Court judge in New York City allowed

[18] Pollard vs. Photographic Co. (1888) L.R. 40 Ch. Div. 418, 58 L.J.Ch. (N.S.) 251, 60 L.T. (U.S. 418).

[19] Moore vs. Rugg (1890) 44 Minn. 28, 9 L.R.A. 58, 46 N.W. 141.

[20] Corlis vs. E. W. Walker Co. (1894) 64 Fed. 280, 31 L.R.A. 283. See also White, Studio Inc. vs. Dreyfoos (1913) 156 A.D. 762, 142 N.Y.S. 37; Press Pub. Co. vs. Falk (1894) 59 Fed. 324; Lumiere vs. Robertson & Cole Dist. Corp. (1922) 280 Fed. 550.

[21] Douglas vs. Stokes (1912) 149 Ky. 506, 42 L.R.A. (N.S.) 386, 149 S.W. 849.

[22] Walmsley vs. Atlas S.S. Co. Ltds. (1900) 50 A.D. 199, 63 N.Y.S. 761.

[23] Lake vs. Dye (1921) 232 N.Y. 209.

[24] See also Barker vs. Lewis Storage and Transfer Co. (1905) 78 Conn. 198; Green vs. Boston & Lowell Railway Co. (1880) 128 Mass. 221; 1 Sutherland on Damages, 4th ed. section 1109-1117; 1 Sedgwick on Damages, 9th ed. sections 250, 251.

$5.00 for the damage of a photograph of the plaintiff's deceased mother.[25] The Court stated that the photograph was primarily an article of *pretium affectionis*, and expressed its sympathies to the plaintiff while stating that the law does not recognize or make allowance for a purely sentimental value. The Walmsley case, about the negatives in the missing trunk (see Footnote 22), was not mentioned in the Court's decision, and appears to have been overlooked.

VII THE PRINT

Section 18. Distinction Between Possession and Publication. The reader must clearly distinguish between the mere possession of a print and the publication of that print. The fine point is important. Publication does not necessarily mean the reproduction of the picture in a newspaper or magazine, although such reproduction is of course one method of publication. The term, however, is far broader, and includes all manners of display. Thus, if a photographer places one of his prints in a case at the entrance to his studio or in the window of his store or shows the picture in question to one or more people other than the subject, he has "published" that print.

There is no question but that a photographer who exposes a film and then makes a print from his negative is clearly entitled to the possession and ownership of that print. What he may do with it after making it is entirely a different question, discussed next in Article IX (page 2233). The entire problem of the right of privacy is involved, and that has been one of the most litigated phases in the entire photo-legal sphere.

[25] Furlan vs. Rayan Pho. Works Inc. (1939) 171 Misc. 839, 12 N.Y.S. (2nd) 921.

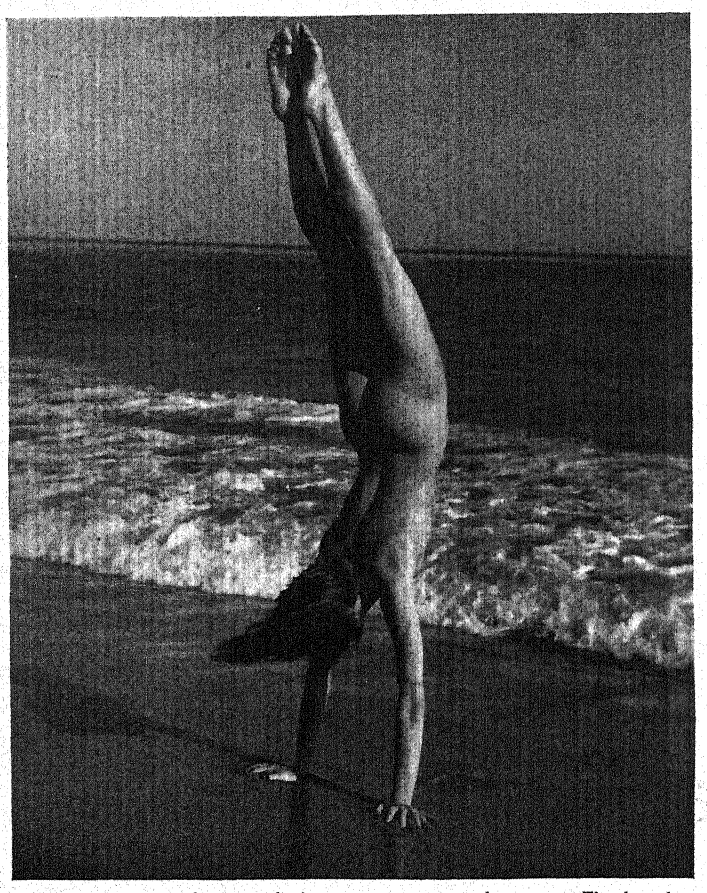


This model, who knowingly posed for a Canadian National Railways publicity shot, still had to sign a formal release. For a sample model's release, see page 2245

Section 19. Obscenity. The mere possession of indecent, lewd, lascivious, filthy or indecent pictures has been made a criminal offense in most states. The statutes are so broadly enacted that it is practically impossible for a person to have such pictures in his possession legally. The New York act[26] states that a person is guilty who has such pictures in his possession with the intent to sell, lend or give away, or even to show them. The intent, of course, is a question for a jury, but it is indeed difficult to imagine a case where one had such prints in his possession without even the intention to show them to others. Similar statutes exists in practically every State.

Section 20. Nudity. Nudity is not necessarily obscene. It is generally recognized that photography is an art and entitled to

[26] N.Y. State Penal Law, Section 1141.



Mere nudity in a photograph does not constitute obscenity. The line between the two is a matter of opinion, of course, but such photographs may be barred from publication or the mails only if they depict matters which have a tendency to corrupt and deprave the morals of those who see it
Photo, Victor Haveman

the same privileges granted other arts, and subject to the same restrictions. Such restrictions are invariably carried further in the field of photography, however, undoubtedly due to the fact that the camera is an instrument of reproduction used by people of all ages and classes. It is unquestionably easier for a dilletante to reproduce recognizable objects with a camera than with a paint brush.

Oddly enough, there are few cases reported regarding photographs of the nude, and the lawyer is compelled to draw upon those decisions concerning nudity in painting, and he finds there analogy and precedent.

The test of obscenity seems to be whether the tendency of the matter charged is to deprave or corrupt; whether its motive so to speak, is pure or impure, and whether it is naturally calculated to excite impure imaginations in a spectator. One of the leading cases[27] stated, "It is evident that mere nudity in painting or sculpture is not obscenity. Some of the great works in painting and sculpture as all know, represent nude human forms. It is a false delicacy and mere prudery which would condemn and banish from sight all such objects as obscene, simply on account of their nudity. If a test of obscenity or indecency in a picture or statute is its capability of suggesting impure thoughts, then indeed all such representations might be considered as indecent or obscene. The presence of a woman of the purest character and of the most modest behavior and bearing may suggest to a prurient imagination images of lust, and excite impure desires, and so may a picture of a statute not in fact indecent or obscene."

The Court took the pains to point out that the words "obscene" and "indecent" are not defined in the statute, since they themselves are descriptive. "They are," the Court said, "words in common use, and every person of ordinary intelligence understands their meaning . . . It does not require an expert in art or literature to determine whether a picture is obscene . . . These are matters which fall within the range of ordinary intelligence . . . "[28]

An excellent statement on the subject was made by a Georgia court[29] which said, "We should keep in mind that the word indecency, as used in the statute has not so

[27] People vs. Mueller (1884) 96 N.Y. 408.
[28] See also U.S. vs. Males (1892) 51 Fed. 41; U.S. vs. Smith (1891) 45 Fed. 476.
[29] Redd vs. State (1910) 7 Ga. App. 575.

broad a meaning as it has in popular speech. An act may be unconventional, may be such as to give offense to the finer sensibilities, may relate to acts which bring a blush (real or feigned) to the cheeks of the prudish, and yet not be indecent. To determine whether an act be indecent within the purview of the statute, the time, the place, the circumstances, and the motives of the actors must be considered."

Section 21. Expert Opinion on Obscenity. Whether or not a picture was obscene was originally a question for a jury to decide in the exercise of its everyday knowledge and experience.[30] The tendency has been, however to allow expert opinion on the subject, and to permit the opinions of qualified persons to be placed before the court of jury.[31] Such expert evidence has been considered rationally helpful. This privilege of allowing expert opinion on the question of whether or not something is obscene was granted in a case involving a book which had been charged as being indecent. The opinion[32] read, "The Court declines to believe that so large and representative a group of people would rally to the support of a book which they did not genuinely believe to be of importance and literary merit. The Court is of the opinion, moreover, that this group of people, collectively, has a better capacity to judge the value of a literary product than one who is more apt to search for obscene pages in a book than to regard the book as a whole."

Section 22. Posing as Indecent Exposure. If a photograph of a nude is not obscene in accordance with the tests laid down above, it would appear logical that there should be nothing illegal in the necessary steps leading to the production of that photograph. The posing of the model in the nude, therefore, under proper auspices and conditions, should be a lawful activity.

While no case is reported on the subject, there have been, nevertheless, two important decisions on the question. In 1940 the Urban Camera Club in New York City was raided and its officers and the model were arrested, charged with having staged an indecent exhibition. The facts were that the Club had announced that anyone interested in such photography might attend the class upon paying a small admission charge which was to cover the model's fee and other incidental expenses. A plainsclothesman attended without a camera, and after the class proceeded for about an hour, he made the arrest and confiscated all of the film in the cameras present as evidence.

Upon trial in the Court of Special Sessions in Bronx County, the complaint was dismissed, the Court indicating that the evidence clearly proved that those who were involved were seriously interested in photography and not merely in the exhibition of a naked body. It was unequivocally shown upon trial that the club was a legitimate organization and a member of a metropolitan council of clubs, and was equipped as one could expect a proper camera club to be. These surroundings were an essential part of the defense.

The Camerateria case held differently. The Camerateria was a commercial enterprise which had several darkrooms and a studio, all of which could be rented by interested photographers upon an hourly basis. The Camerateria also conducted classes in all phases of photography, including life classes. Anybody interested could attend upon payment of a fee, which included a small legitimate profit for the proprietors.

A police officer attended three such classes and took approximately one hundred pictures, many of which appeared however to have been taken between poses and from unintended angles. The Court of Special Sessions in New York County convicted the defendants and an appeal is pending at the time of this writing. The writer respectfully disagrees with the decision of the Court and believes that the decision may be reversed.

There are, however, certain differences between the two cases which evidently influenced the Court, although the writer is of the opinion that the distinctions are not important enough to justify such different conclusions. In the Urban Camera Club case, not a single photograph exhibited in evidence was indecent or obscene. In the Camerateria case, a very few of the hundred pictures offered in evidence were admittedly

[30] See People vs. Mueller, Footnote 27, supra.
[31] People vs. Larsen (1938) 5 N.Y.S. (2d) 55.
[32] People vs. Viking Press (N.Y. 1933) 147 Misc. 813.

questionable, due in part to the fact that the police officer had taken them from side angles and between poses. The writer maintains, and believes the point legally sound, that the Court erred in singling out these few prints. Cases have held that one cannot judge the decency of a book by referring only to isolated pages instead of considering the book as a whole.

That the surroundings and circumstances are important was brought out in a case involving a book where the Court[33] said, "We do not doubt that whether a book is obscene or not may in some cases depend on circumstances. For example, a medical book for the instruction of medical men may contain illustrations suitable and proper as a part of the work, but which, if detached and published alone for circulation, might be deemed indecent within the statute." Similarly, the auspices of a life class in photography, and the type of people attending, and all other incidental facts, are of vital importance in determining whether or not it is an indecent exhibition.

Similar cases on the photography of the nude have appeared elsewhere, and the motive of the defendants has invariably been the deciding factor. Life classes in painting and sculpture have been in existence since time immemorial, and the same latitude is given or should be given to the photography class, providing, of course that all other tests of decency and propriety are met.

As to the individual photographer, there does not seem to be any question but that he has the same right as any other artist. With the individual, as distinguished from the class, there is rarely any question of decency raised.

VIII TRANSPORTATION

Section 23. Postal Regulations. Under ordinary circumstances the only problem involved in the transportation of photographs is that of obscenity. It is illegal to send through the mail an "obscene, lewd, lascivious or filthy" picture.[34] The words, "obscene, lewd and lascivious" have been interpreted to refer only to matters which are immoral by reason of their relation to sexual impurity.[35]

In order to determine whether a photograph is proper mailable matter or not by reason of questionable obscenity, the courts have applied the test of determining if the photograph has a tendency to corrupt and deprave the morals of those into whose hands such a photograph may come.[36] It is immaterial whether or not the person who mailed the obscene photograph knew of its lewdness. The very mailing is sufficient to constitute a violation of the regulations.[37] The only question raised in such a case is the issue of whether or not the photograph was in fact obscene.[38]

Whether a particular photograph of a nude is a work of art or an obscene picture, may often be a close question of fact which cannot be decided unless all the circumstances are considered. In one case,[39] for example, pictures of nude women in lots of fifty were sent through the mails by the defendant. Some of these were copies of well known paintings and others were lascivious pictures. The Court, admitting the possibility that a case might arise where it might be difficult to determine whether the Statute applied, held nevertheless that in this particular case it was obvious that the photographs were sent through the mails for the sole purpose of profitably pandering to the lewd and lascivious and the defendant was convicted. Unfortunately, the case was meagerly reported and it is difficult to express an opinion regarding it.

In another interesting case[40] the defendant had in his possession a large number of obscene pictures. These pictures were not mailed by him but he did send letters which set forth where such pictures might be obtained. These letters, sent through the mail together with the possession of the obscene pictures, indicated a clear use of the mails with intent to convey information concerning obscene photographs and a conviction resulted.

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[33] See People vs. Mueller, Footnote 27, supra.
[34] 18 U.S.C.A., Sec. 334, Criminal Code.
[35] U.S. vs. Davidson (1917) 244 Fed. 523.
[36] Knowles vs. U.S. (1909) 170 Fed. 409; McFadden vs. U.S. (1908) 165 Fed. 51.
[37] Rosen vs. U.S. (1896) 161 U.S. 29.
[38] Burton vs. U.S. (1906) 142 Fed. 57.
[39] Lynch vs. U.S. (1922) 285 Fed. 162.
[40] U.S. vs. Brimm (1892) 50 Fed. 528.

Aside from the question of obscenity, recent regulations due to the National Emergency have made it illegal to transport through the mails any pictures of any military encampment, fort, arsenal, base, bridge, or other object necessary to the national defense.

Only a short time ago the importation and interstate transportation of prize fight films were prohibited.[41] This law, however, was repealed on June 29th, 1940.[42]

Section 24. Loss in Transit. Occasionally negatives or photographs are lost in the mail or lost while being transported by some other method. The only question which arises is the one regarding the value of the negative or the photograph. The law in this regard is no different from the question of loss during processing which is fully discussed in Section 17.

IX PUBLICATION

A. RIGHT OF PRIVACY

Section 25. General Statement. Probably no single question in the photo-legal sphere arises as often for the photographer as the omnipresent problem of how far he can go with a picture he has taken of some other person. This phase of the law has resulted in more litigation in the photographic field than all its other lawsuits put together. Considerable explanation is therefore necessary to enable the photographer to grasp the various distinctions involved.

Any rule of law has its beginning either in the common law or in statute. The former is the binding force of judicial precedents without the aid of legislative enactments. It is indeed peculiar that the courts in some States have found a "right of privacy" to exist under the common law, while the learned jurists of other jurisdictions failed to make a similar discovery, and required legislative enactment to fill the need. No such right appears ever to have been mentioned in Blackstone, Kent or any of the other great commentators upon the law.

"The Right of Privacy" doctrine as applied to a photograph originated in the excitement which followed the flashlight photograph of an actress who appeared on a New York stage in tights. Although the case was not contested and no official report is in existence, the facts are found in the newspapers of the day.[43] The case has historical significance only as the forerunner of considerable litigation. Soon after the photographer published this picture of the actress which he had taken without her consent, an article appeared in the Harvard Law Review[44] which actually introduced a long drawn out controversy on the "Right of Privacy."

The question first reached the New York Court of Appeals in 1902 where a young lady sought to enjoin the use of her portrait upon the label of a flour manufacturer. The Court[45] went into an exhaustive study of the matter as a new question of law before reaching the decision that there was no such thing as a Right of Privacy unless based upon some property right.

The nearest analogy to be found involved none other than England's Prince Albert. The Queen and the Prince had been making etchings and drawings for their own amusement and had struck off copies from the etched plates for their friends. A workman printed some of these for himself at the same time and Prince Albert sought to enjoin him from exhibiting or cataloging them. The English Court[46] granted the injunction because of the fact that the Prince had a *property right* to the etchings, and the decision is clearly based upon the fact that they were his *property* and could not be used by anyone else. Similarly, in another English case,[47] a young lady engaged a photographer to make her portrait and the photographer then sold copies of the picture as Christmas cards. Here, too, the Court granted the injunction on the ground that there was an implied *contract* not to use the negative except to make pictures for the sitter. Again the *property right* of the plaintiff was the basis of the decision. Similar

[41] 18 U.S.C.A., Sections 405, 406 and 407.
[42] 54 U.S. Statutes, 686.
[43] Manola vs. Stevens, N.Y. See New York Times, June 15, 1890.
[44] 4 Harvard Law Review, 193, December 1890.
[45] Roberson vs. Rochester Folding Box Co. (1902) 171 N.Y. 539.
[46] Prince Albert vs. Strange (1849) 1 Macn. & G. 25; 2 De G. & S. 652.
[47] Pollard vs. Photographic Co. (1888) L.R. 40 Ch. Div. 345.



The photographer is subject to all laws which govern other people. His desire to take a photograph does not change the fact that he is violating a law by actually trespassing on private property

cases[48] were all decided on the *property right* to the photograph or manuscript involved.

One of the early American cases involved a suit brought by the plaintiff to restrain the publication of his picture in connection with an article on his life. The Court[49] did enjoin the use of the portrait basing its decision here, too, on the *property right* and the further fact that the picture had been obtained upon certain conditions with which the defendant had not complied.

From these cases, therefore, came the foundation of the New York law to the effect that there is no right of privacy separate and apart from the pure property right to a picture. In that first New York case the Court pointed out, moreover, that the likeness used on the flour label was a good one. The plaintiff herself admitted that it was excellent and argued, therefore, that anybody who knew her could not fail to recognize her. The Court took the pains to indicate that had it been a bad photograph it might have been libelous, in which event a different type of action might possibly accrue to the plaintiff. As a result of this decision many other jurisdictions have similarly denied the so-called right of privacy and failed to find its justification in the common law.[50]

On the other hand other States clearly recognized the existence of a right of privacy without resorting to the use of a *coupled property right*. In one case[51] the plaintiff collected damages for the unauthorized use of his photograph beside that of a shabbily dressed person, the accompanying advertisement indicating that he had bought insurance while the other had not. The Court stated that he did not have to show special damages and that the mere invasion of his privacy without his knowledge or consent constituted the gravamen of the action.

A later case[52] allowed damages for the parents of a child who had been born with his heart on the outside of the body. The hospital in which the child was born had permitted a photographer to take pictures of the child before his death, and these pictures had appeared in a local newspaper.

New Jersey also recognized the common law right of privacy[53] as did Kentucky,[54] Missouri[55] and Kansas.[56]

Section 26. Present Right of Privacy. Despite the contrary decisions which are set forth above, the right of privacy exists today in most jurisdictions. Where the courts have failed to recognize the existence of such a common law right, as in New York, statutes were almost universally enacted to create such a right. In New York the statute came the very next year after its Courts had failed to afford individuals protection from the almost unrestricted use of their phtographs.

[48] See Marhall vs. Higbey, (1862) 1 H. & C. 188: Gee vs. Pritchard (1818) Swanst. 402: Abernethy vs. Hutchinson (1825) 3 L.J. Ch. 209, 1 H. & T.W. 28.

[49] Corliss vs. Walker Co. (1893) 57 Fed. 434, 64 Fed. 280.

[50] Hillman vs. Star Pub. Co. (1911) 64 Wash. 691, 117 Pac. 594; Atkinson vs. Dougherty & Co. (1899) 121 Mich. 372, 80 N.W. 285; Henry vs. Cherry & Webb (1909) 30 R.I. 13, 73 Atl. 97.

[51] Pavesich vs. New England Life Ins. Co. (1905) 122 Ga. 190, 50 S.E. 68.

[52] Bazmore vs. Savannah Hospital (1930) 171 Ga 257, 155 S.E. 194.

[53] Edison vs. Edison Plyform (1907) 73 N.J. Eq. 136, 67 Atl. 392.

[54] Foster-Milburn Co. vs. Chinn (1909) 134 Ky. 424, 120 S.W. 364, also see Douglas vs. Stokes (1912) 149 Ky. 506, 149 S.W. 849.

[55] Munden vs. Harris (1911) 153 Mo. App. 652, 134 S.W. 1076.

[56] Kunz vs. Allen (1918) 102 Kan. 883, 172 Pac. 532

Not only did the new law make it a criminal offense to use the photograph of any living person for advertising or trade purposes without that person's consent,[57] but full civil rights were also given to such aggrieved persons.[58] Under this statute, any person can enjoin the use of his picture for any trade purposes if it is so used without his consent.[59] This New York statute, together with the modifications discussed herein, is a fair statement of the law as it exists today in most States, whether that result was achieved by statute or by judicial interpretation of the so-called common-law right of privacy.

No hard and fast rule, however, can be laid down. Law is, despite popular belief, constantly changing to meet constantly changing conditions. Law is not stagnant in an active world. One must examine the latest decisions and statutes in his own jurisdiction to determine the existing law therein.

Section 27. Advertising Purposes Defined. Much confusion and hair-splitting resulted from the phrase "advertising or trade purposes" in connection with the use of photographs. As with every statutory enactment, the words of the legislature had to be defined and interpreted by the judicial decision of the courts.

In one interesting case,[60] the plaintiff paid a photographer to have her portrait made. Without the consent of the sitter the photographer then sold a copy of the portrait to a publisher who used it to promote the sale of a book on "Hair Culture." This was held clearly to be a use of the photograph for advertising or trade purposes.

On the other hand, an earlier case[61] held that a newspaper could not be enjoined from publishing the picture of the plaintiff in connection with a series of articles it was printing about him. The plaintiff unsuccessfully maintained that this was a use of his picture for trade purposes, since it enabled the newspaper to sell more copies and thereby increased its circulation. The court stated, "This stretches the language of the statute *ad absurdum*." Quite recently advertising purpose was defined as a solicitation of patronage[62] and unless the picture appears in, or as part of, an advertisement, no violation of the statute arises.

Similarly, the Court could find no advertising or trade purpose where a newspaper had published the picture of a young lady in an Inquiring Reporter's column,[63] even though this daily feature might increase the periodical's circulation.

Even when a group picture was used as a frontispiece to a book, an individual in that group was denied recovery, since the picture had not been used to promote sales of the book. The volume was entitled "I Break Strikes," and the photograph which was used in the book was captioned, "Members

[57] Civil Rights Law, Section 50.

[58] Civil Rights Law, Section 51.

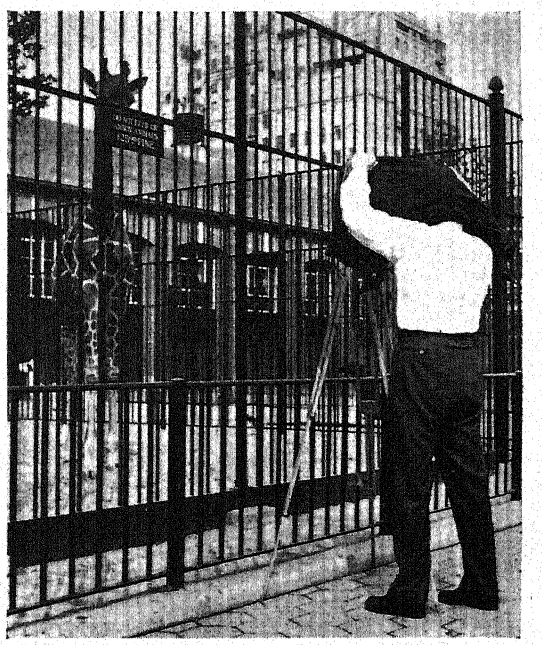
[59] Constitutionality of the statute was upheld in Rhodes vs. Sperry & Hutchinson (1907) 120 A.D. 467, 104 N.Y.S. 1102 Affd. (1908) 193 N.Y. 223, 85 N.E. 1097, Affd. (1911) 220 U.S. 502, 31 Sup. Ct. Rep. 490, also see Wyatt vs. James McCreery Co. (1908) 126 A.D. 650, 111 N.Y.S. 86.

[60] Riddle vs. MacFadden (1906) 116 A.D. 353, 101 N.Y.S. 606, affd. (1911) 201 N.Y. 215, 94 N.E. 644.

[61] Jeffries vs. N. Y. Evening Journal Pub. Co. (1910) 67 Misc. 570, 124 N.Y.S. 780.

[62] Sarat Lahiri vs. Daily Mirror (1910) 162 Misc. 570; 124 N.Y.S. 780.

[63] Middleton vs. News Syndicate Co. Inc. (1937) 162 Misc. 516, 295 N.Y.S. 120.



This photographer may be disregarding the rules of the zoo, since most zoos prohibit the use of tripods in order to exclude commercial photography. You may shoot to your heart's content while holding the camera in your hand, however, unless that too be specifically restricted

of Bergdorf's Army." The Court[64] stated that this was not utilizing a photograph for advertising or trade purposes, although the same picture might have been so used had it been coupled with an advertisement the purpose of which was to stimulate sales of the book.

Where a five and ten cent store sold lockets which contained a picture of an actress, this was held to be for advertising or trade purposes since it was a solicitation of patronage. The Court[65] held that the use of the picture made the locket more attractive, and hence stimulated its sale. It is difficult to reconcile the two opinions, since the facts in both cases appear to present the same legal problem.

It is interesting to note and significant to remember that the damages which are recoverable by an actor or an actress for the unauthorized use of his or her picture in connection with an advertisement may be substantially less than the damages recoverable by a private individual. In one case[66] a retail shoe outfit used a photograph of Sylvia Sidney, the motion picture star, without her permission, and the defense interposed was that a custom exists in the theatrical profession whereby persons in it permit, and in fact encourage, the use of their photographs in trade advertisements without compensation or consent because of the attending publicity. The case itself did not definitely decide that such a custom does exist, but nevertheless a motion to strike out this defense was denied, so that at least the defendant was given the opportunity of trying to prove upon the trial that such a custom is in force.

Although no later report was published to show the result of this case, it may be safely said, in conclusion, that one cannot use the picture of any person, without consent, for advertising or trade purposes, but the damages which might be awarded to an actor or actress are undoubtedly considerably less than what might be awarded to a private person.

Section 28. Appearance in Motion Pictures. An interesting distinction has been drawn by the courts between the two types of motion pictures. A person cannot prevent an ordinary newsreel from including his picture, nor can he recover damages because of such involuntary appearance.[67] On the other hand, the appearance of a person in a motion picture dramatization of an actual event in which he was one of the chief participants was held to come within the inhibition of the New York statute.[68]

The two situations are not inconsistent. In the latter, a feature of current interest was fictionalized in a film. The emphasis was on the dramatic rather than upon information. The newsreel pictures, however, are strictly for informative purposes of current events and one could hardly conceive, for instance, that the inclusion of a passer-by in a current newsreel about a big fire should give that passer-by the right to sue the makers of the newsreel or the theater in which it was exhibited. Such a rule would be tantamount to prohibiting newspapers from mentioning any names whatsoever in its news columns.

Section 29. Newspaper Pictures. An excellent summary as to the use by a newspaper of photographs was contained in the Lahiri case,[69] in which Mr. Justice Bernard L. Shientag stated, "The rules applicable to unauthorized publication of photographs in a single issue of the newspaper may be summarized generally as follows:

"1. Recovery may be had under the statute if the photograph is published in or as part of an advertisement, or for advertising purposes.

"2. The Statute is violated if the photograph is used in connection with an article of fiction in any part of a newspaper.

"3. There may be no recovery under the Statute for publication of a photograph in connection with an article of current news or immediate public interest.

[64] People vs. McBride & Co. (1936) 159 Misc. 5, 288 N.Y.S. 501.

[65] Lane vs. F. W. Woolworth Co. (1939) 171 Misc. 66, 11 N.Y.S. (2d) 199, affd. (1939) 12 N.Y.S. (2d) 352.

[66] Sidney vs. A. S. Beck Shoe Corp. (1934) 153 Misc. 166, 274 N.Y.S. 559.

[67] Humiston vs. Univ. Film Mfg. Co. (1919) 189 A.D. 467, 178 N.Y.S. 752.

[68] Binns vs. Vitagraph Co. of Am. (1913) 210 N.Y. 51, 103 N.E. 1108, L.R.A. 1915C 839, Ann. Cas. 1915B 1024. See also Blumenthal vs. Picture Classics Inc. (1932) 235 A.D. 570, 257 N.Y.S. 800.

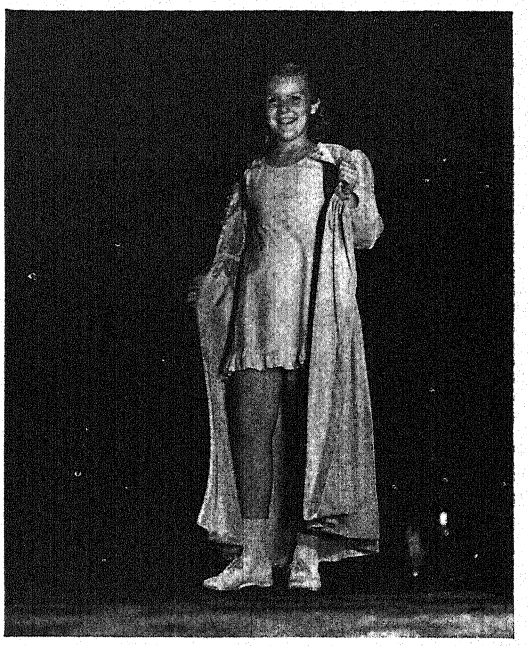
[69] See Sarat Lahiri vs. Daily Mirror, footnote 62 supra.

"4. Newspapers publish articles which are neither strictly news items nor strictly fictional in character. They are not the responses to an event of peculiarly immediate interest but, though based on fact, are used to satisfy an ever-present educational need. Such articles include among others, travel stories, stories of distant places, tales of historic personages and events, the reproduction of items of past news, and surveys of social conditions. As a general rule, such cases are not within the purview of the Statute."

Section 30. Consent. Even where the right of privacy has been fully recognized, the consent of the photographed person removes him from the protective sphere. The question does arise occasionally, however, whether or not the consent granted was exceeded. In one case [70] it was held that the plaintiff could not complain of the use of his photograph when he had submitted it in a prize contest together with a testimonial letter which had won an award in the competition. He had authorized publication of his photograph "for other advertising purposes," which was considered broad enough to warrant the use of the photograph in a number of magazines of national circulation.

Needless to say, where the person whose picture is used is a minor, his consent is insufficient and such consent must be obtained from the parent or guardian.[71]

Good practice requires that the consent to the use of a picture be in writing. In some jurisdictions the law specifically makes such written consent a requisite. Even in those States where such consent need not be in writing, the question of whether or not consent was actually given, if it was oral, is difficult to prove, and the photographer would be wise to obtain such permission in writing so as to leave no question of doubt. Where written consent is absolutely necessary, the fact that oral consent was given, while not enough to prevent the plaintiff from suing, nevertheless does appear to mitigate the damages.[72]



In order to publish this picture, the specific consent of four sources was involved. The photograph was taken at a children's fashion show and permission had to be secured from: the sponsor of the show, from the girl's parent, and from the maker of the garment

Where a person knew of the purpose for which his picture was taken, and voluntarily made himself a part of it, it would appear that such action on his part is tantamount to consent, but nevertheless cases hold that such apparent consent is insufficient where the stature requires such consent to be in writing.[73]

Nevertheless, another case [74] went out of its way to prevent the issuance of an injunction where the Court believed that fraud was involved. An employee had posed for a photograph taken at his machine and this picture was used in conjunction with his employer's advertising. After leaving that particular job, the plaintiff then sought to restrain the use of his photograph, saying that he had never given his written consent as

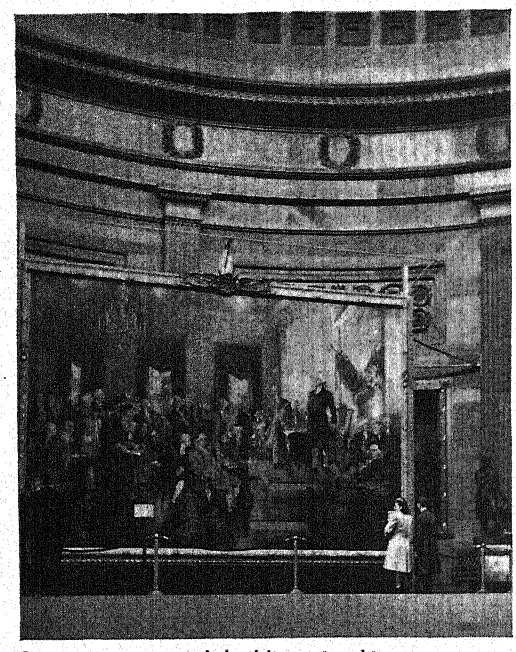
[70] Marek vs. Zanol Products (1937) 298 Mass. 1, 9 N.E. (2d) 393.

[71] Semler vs. Ultem Pub. Inc. (1938) 170 Misc. 551, 9 N.Y.S. (2d) 319; Wyatt vs. Wanamaker (1908) 58 Misc. 429, 110 N.Y.S. 900, affd. (1908) 126 A.D. 656, 111 N.Y.S. 90; Colyer vs. Fox Pub. Co. (1914) 162 A.D. 297, 146 N.Y.S. 999.

[72] Harris vs. H. W. Gossart Co. Inc. (1921) 194 A.D. 688, 185 N.Y.S. 861.

[73] Almind vs. Seabeach R.R. Co. (1913) 157 A.D. 230, 141 N.Y.S. 842, ref. (1912) 78 Misc. 445, 139 N.Y.S. 559.

[74] Wendell vs. Condurt Mach. Co. (1911) 74 Misc. 201, 133 N.Y.S. 758.



Certain regions and buildings in this country are barred to photographers by order of the government. This prohibition usually guards military secrets. However, few people know that it is forbidden to take pictures inside the Capitol at Washington without specific permission

the statute in that State required. The Court stated that although this was true, nevertheless the statute was never intended to enable an employee fraudulently to mislead his employer, and consequently, it refused to grant the former employee the remedy he sought. Unless fraud can be invoked, this decision does not have general applicability.

Section 31. Public and Private Persons. Although the Corliss case[75] was decided on the question of a property right, nevertheless its *dictum* did much to establish the theory that there is a substantial difference in the privacy rights of an ordinary person and one who is in the public limelight. George H. Corliss, a famous inventor, sought to prevent the publication of his portrait in connection with a biography of his life. In denying the injunction, the Court stated, "A private individual should be defended against the publication of any portraiture of himself, but where an individual becomes a public character, the case is different. A statesman, author, artist or inventor, who asks for and desires public recognition may be said to have surrendered this right to the public. When anyone obtains a picture or photograph of such a person, and there is no breach of contract or confidence in the method in which it was obtained, he has the right to reproduce it whether in a newspaper, magazine, or book."

Similarly, where a person, willingly or not, participates in any public event and thereby emerges from his private seclusion, there is no invasion of his right of privacy when a photograph is published in connection with the description of the event.[76] Even a suicide forfeits the so-called right of privacy by entering, upon his death, the public limelight which attends such a violent decease.[77]

Actors and actresses certainly are among the public individuals. Where a defendant sold without restraint caricatures of motion picture stars without their consent, he could not legally be prevented from doing so.[78]

Persons who have been convicted of a crime are also without the protective group, and their pictures may be published.[79] In this connection, however, it is interesting to note that Colorado has a statute[80] which makes it a criminal offense to print or publish in any periodical the picture or the name of any child who may be involved in any rape case or any violation of the contributory delinquency or dependency laws. The statute goes on[81] to make it a crime even to take a photograph or make a sketch or picture of any such child.

Section 32. Deceased Persons. The reproduction of a photograph of a deceased person does not enable the heirs to maintain an action because the use of that picture was unauthorized.[82] Furthermore, an action for the unauthorized use of a picture of a living person terminates upon the death of that

[75] Corliss vs. Walker Co., footnote 49 supra.

[76] Jones vs. Harold Post Co. (1929) 230 Ky. 227, 18 S.W. (2d) 972.

[77] Metter vs. Los Angeles Examiner (1939) 35 Cal. App. (2d) 304, 95 Pac. (2d) 491.

[78] Paramount Pictures Inc. vs. Leader Press Inc. (1938) 34 Fed. 1004.

[79] Hodgeman vs. Olsen, (1915) 86 Wash. 615, 150 Pac. 1122; Mabry vs. Kettering (1909) 89 Ark. 551, 117 S.W. 746.

[80] Chap. 33 Col. Stat. Ann. 1935, Sec. 76; See Lindsey vs. People (1919) 66 Col. 343, 181 Pac. 531.

[81] Chap. 33 Col. Stat. Ann. 1935, Sec. 77.

[82] Patterson vs. Colgate & Co. (1926) 129 Misc. 417, 220 N.Y.S. 677.

person.[83] The action does not survive the plaintiff's death.

Section 33. Scientific Photographs. The law is hardly settled on the question of the unauthorized use of a photograph for scientific purposes. In one case,[84] a physician took "before and after" pictures of a woman and these pictures were used in a medical journal as part of an article bearing the title, "The Saddle Nose." The Court held that it was impossible to determine from the complaint alone whether the photographs were used for advertising or trade purposes or for genuine scientific purposes, and decided that the complaint should not be dismissed but that the matter should go to trial and at such trial a jury could decide what the real purpose of the article was. The implication seems to be that if the use of the photographs was peculiarly scientific, then, while such purpose might not necessarily bar the action entirely, it might mitigate the damages to a point where a six-cent verdict might be proper. The Court cautioned, however, that it must be determined whether an article, even in a scientific publication, might not be only someone's advertisement in disguise. No hard and fast line can be drawn and each case depends upon its own facts, with the obvious conclusion being that the use of photographs for scientific purposes does not appear to be completely unrestricted, but damages in such cases would be so small as to make litigation unprofitable.

In this connection, however, it is interesting to note that in 1934 the Attorney General of the State of New York wrote an opinion that the State Department of Health might not legally use photographs of persons afflicted with cancer for public display without obtaining their consent.[85] Such an attitude, however, may have been induced by a desire for extreme caution. Such an opinion does not have the weight of law.

Section 34. Exhibition by Photographer. Any photographer has the right to exhibit pictures which he has made, even though such pictures or exhibits are for the purpose of advertising himself as a photographer. The New York Statute[86] specifically grants the photographer the right to exhibit specimens of his work in and about his establishment. It permits the person whose picture is so displayed, however, to object, and if the photographer receives a written notice of such objection, he may no longer display the particular picture involved.

There is no case reported which involves the exhibit of a photograph by a photographer in connection with a photographic exhibition or salon. It is believed, however, that despite the New York statute which specifically restricts such dispaly to "in or about his establishment," nevertheless, a photographic exhibition appears to be a proper place for the display of photographs. It can hardly be argued that such display is for trade or advertising purposes, but is rather an exhibition of photography in general as an art or science.

B. LIBEL

Section 35. General Statement. There is no question but that a person may be libeled by the publication of a photograph. Here again it is necessary to recall the definition of the word "publication," as set forth in Section 18 supra, page 2229.

Newall, in his distinguished treatise on Libel and Slander states, "A man may be as effectually held up as an object of ridicule, contempt, or hatred by means of a picture as by the more labored form of words. In legal consideration, the only question is whether the mode of defamation which has been adopted be capable of conveying that meaning which is detrimental to the plaintiff."[87] The gist of the libel law is that disgrace, contempt or ridicule cannot be brought upon a person with impunity and it is immaterial by what means or method the person be defamed.[88]

Section 36. Picture with Correct Name. If a newspaper or other periodical uses the picture of a person, correctly gives the name of that person, and places it with an article of a libelous character, there seems to be no question but that the person aggrieved has

[83] Wyatt vs. Hall's Portrait Studio (1911) 71 Misc. 199, 128 N.Y.S. 247.

[84] Griffin vs. Medical Society of N.Y. (1939) 11 N.Y.S. (2d) 109.

[85] 1934, Opinions Attorney General N.Y., 374.

[86] Civil Rights Law Sec. 51.

[87] Newall, Libel & Slander, 4th ed. P. 267.

[88] Merle vs. Sociological Res. Film Corp. (1915) 166 A.D. 376, 152 N.Y.S. 829; De Sando vs. N. Y. Herald (1903) 88 A.D. 492, 85 N.Y.S.

a right to recover damages. The only questions are those ordinary issues which are raised in any libel suit. Although such cases are not infrequent, such litigation usually is decided on the basis of the article itself, not the photograph.

Occasionally, however, a different type of cases arises and involves the photograph directly. Where, for instance, a newspaper published an article about a dancer and, to illustrate it, used pictures of that woman which had been posed in the nude, this was held to be a libel.[89] There was no question that the woman had posed for these pictures, and had the article been about art, the picture may not have been libelous. In connection with an article about her dancing, however, it was an improper connection. It is important, therefore, to distinguish the uses to which the photograph is put.

The misleading use of an accurately named photograph may in some circumstances constitute libel. In one case[90] a burlesque theater had a display in its lobby of pictures of a number of women, some of whom were dressed, and others scantily attired. The display was headed by the title, "Oriental Beauties," and below the pictures were the words, "Minsky's Midsummer Follies." The plaintiff's fully clothed picture was included, but she had absolutely no connection whatsoever with the burlesque theater. She was a serious actress and known as a tragedienne. The trial judge was affirmed in his statement, "I find that the inference the observer would draw from this display was that the women whose pictures there appeared, including the plaintiff, were actresses in the defendant's burlesque shows and in the play there advertised . . . Regarding her as an actress of tragedy and the better class of plays, I find that the display would also injure her in her profession, trade or occupation."

Often the caption used under an accurately named photograph may make the combination of picture and caption libelous. So, where the plaintiff's picture was used above the words "Fatty Arbuckle's Lady Love," the publication was held libelous, since the plaintiff was a married woman and therefore held up to disgrace by the combination of picture and caption, which imputed an illicit relationship between her and the obese comedian.[91]

Similarly, a picture of the one-time wrestling champion, Zbyszko, was held libelous[92] when captioned, "Stanislaus Zbyszko, the Wrestler, not Fundamentally Different from the Gorilla in Physique." The athlete's picture was placed next to that of a gorilla.

Section 37. Picture Without Name. Where the picture of an individual is used without any name under it, the test would appear to be whether or not the accompanying article is libelous. Here, as in the section just above, the problem is usually not a photo-legal one, but rather a question of general libel law, depending primarily on the general nature of the article itself, and its justification, if any.[93]

A newspaper, for example, published an article about dishonest auctioneering and illustrated it with an untitled picture of the plaintiff who was not even an auctioneer. The Court[94] said, "While it is true the article does not use the plaintiff's name or otherwise identify him except by the picture, one may be libeled by having his picture printed in such fashion as to expose him to public contempt."

Similarly, an unnamed picture of a girl on a pamphlet entitled "Experiences of a Giddy Typewriter Girl" was held a question for the jury since it held the girl up to ridicule, even though not necessarily imputing unchastity or disgraceful conduct.[95]

On the other hand, recovery was denied an eighteen-year old girl who sued a newspaper because it published a picture of her which had been taken sixteen years earlier. The girl's name was not used but the caption stated, "Homeless Children Sent to Child-

[89] Meyers vs. Afro-Am. Pub. Co. Inc. (1938) 169 Misc. 429, 5 N.Y.S. (2d) 223.

[90] Louka vs. Park Entert. Inc. (1936) 294 Mass. 268, 1 N.E. (2d) 41.

[91] Sydney vs. MacFadden News Publishing Co. (1926) 242 N.Y. 208, 151 N.E. 209.

[92] Zbyszko vs. N.Y. Am. (1930) 228 A.D. 277, 239 N.Y.S. 411.

[93] McCue vs. Survey Assoc. Inc. (1919) 106 Misc. 160, 175 N.Y.S. 346.

[94] Jackson vs. Consumers Pub. Inc. (1939) 256 A.D. 708, 11 N.Y.S. (2d) 462.

[95] Morrison vs. Smith (1904) 177 N.Y. 366, 69 N.E. 725.

less Homes." The Court held that this neither disgraced nor humiliated the plaintiff.[96]

One of the most interesting cases which excited national comment was the suit brought by a well-known society horseman whose picture was used in connection with a cigarette endorsement. The noted steeplechaser posed for the picture in question willingly, and was paid for the testimonial, but he did not see the photograph before it was actually used. By a quirk of lighting the picture showed the celebrated rider with his hand under the pommel, and the side girth fell loosely in such a way that it seemed to be attached to the plaintiff's middle rather than to the saddle. Obscene implications were immediately apparent and the picture was undoubtedly open to ribald interpretation without any difficulty whatsoever. The Court[97] said, "If the advertisement is a libel, it is such in spite of the fact that it asserts nothing whatever about the plaintiff, even by the remotest implications . . . it is patently an optical illusion, and it carries its correction on its face as much as though it were a verbal utterance which expressly declared it was false . . . Notwithstanding all we have said, it exposed the plaintiff to overwhelming ridicule . . . it in fact made of the plaintiff a preposterously ridiculous spectacle; and the obvious mistake only added to the amusement. Had such a picture been deliberately produced, surely every right-minded person would agree that he would have had a genuine grievance; and the effect is the same whether it is deliberate or not."

Section 38. Picture with Similar Name. Sometimes a newspaper publishes an article about Mr. A.B.C. which is entirely true of him, but accidentally the periodical uses a photograph of an entirely different Mr. A.B.C. who has had nothing to do with the matter except for the unfortunate coincidence of exact name. This was done by a Missouri newspaper in connection with a scathing article about strikebreakers, and the Court[98] held that it was no defense for the publication to plead that it had acted in good faith and had merely made a natural error.

In another case a newspaper published an article about Mr. Y.Z. and used a portrait of Mr. A.Z. to illustrate it. A.Z., it so happened, had nothing to do with the matter, and the Court[99] held that it was a question of fact for a jury to decide whether a person reading the article and seeing the portrait would believe that the article referred to the plaintiff. If the article was libelous, and some people might believe it was about the plaintiff, because of the use of his picture, damages would be recoverable.

Section 39. Picture with Wrong Name. It has generally been held that the publication of a person's portrait over a caption giving the name of another is libelous, and the person whose portrait is used may recover damages.[100]

Where a testimonial for whiskey was signed by one person but was accompanied by the portrait of the plaintiff, this was held to be a publication concerning the plaintiff despite the fact that another's name was signed to the statement concerning the qualities of the liquor.[101] As such then, it was libelous.

Where a newspaper printed the plaintiff's picture together with an article describing a murder and referred to the picture as that of the murderer, this was held to be a clear libel despite the fact that the killer's name had been used and his name was entirely different from that of the plaintiff's.[102]

Section 40. Picture of a Place. A picture of a place, instead of a person, may also constitute libel under certain circumstances. Where, for instance, a moving picture showed a factory as a resort of white slavers and the picture included clearly the sign

[96] Knickerbocker vs. Press Pub. Co. (1911) 143 A.D. 138, 127 N.Y.S. 969.

[97] Burton vs. Crowell Pub. Co. (1936) 82 Fed. (2d) 154.

[98] Farley vs. Evening Chronicle Pub. Co. (1905) 113 Mo. Appl. 216, 87 S.W. 565.

[99] Ball vs. Eve. Am. Pub. Co. (1908) 237 Ill. 592, 86 N.E. 1097, ref. 142 Ill. App. 656. See also Clarry Squire vs. Press Pub. Co. (1901) 58 A.D. 362, 68 N.Y.S. 1028; Farrington vs. Star Co. (1927) 244 N.Y. 585.

[100] Peck vs. Tribune Co. (1909) 214 U.S. 185, 53 L. Ed. 960, 29 S. Ct. 554, 16 Ann. Case 1075; De Sando vs. N. Y. Herald Co. (1903) 88 A.D. 492, 85 N.Y.S. 111; James vs. Ft. Worth Tel. Co. (1909)—Tex.—, 117 S.W. 1028; Wandt vs. Hearst's Chic. Am. (1906) 129 Wisc. 419, 109 N.W. 70.

[101] Peck vs. Tribune Co. See footnote 100 supra.

[102] James vs. Ft. Worth Tel. Co. See footnote 100, supra.

which stated the owner's name, the Court[103] held that this was a clear libel inasmuch as the concern involved was a legitimate manufacturer.

Similarly, a photograph of a responsible bank, accompanying an article on crooked banking, was held a libel of the institution a picture of which had been used.[104]

Section 41. Changes in Photographs. Retouching or changing a photograph may sometimes lead to a libel suit. In one case[105] a picture had been taken of five people and three of these were blotted out by the air-brush method, leaving only the plaintiff and her chauffeur. This picture was used over a caption "Principals in local Divorce Scandal." The Court felt that a jury was warranted in finding the publication defamatory, since it did create the implication of improprieties between the plaintiff and her chauffeur.

Section 42. Intent. It must be noted that the question of intent is never a factor. If libel has been done, it is not an excuse to maintain that it was by unwitting mistake.[106] Chief Justice Holmes of the United States Supreme Court once stated, "There was some suggestion that the defendant published the portrait by mistake and without knowledge that it was the plaintiff's portrait or was not what it purported to be, but the fact, if it was one, was no excuse. If the publication was libelous, the defendant took the risk."[107]

Another case[108] indicates, however, that an accidental error, while not constituting a defense, might have some bearing on the question of the amount of the damages.

Section 43. Summary. A fine statement of the law appeared in the Wandt case[109] where the plaintiff's portrait was used as that of a woman who had committed suicide. The Court said, "It seems quite true that persons who knew the plaintiff well, and knew her residence and family, would probably not be misled, but would at once conclude that the picture was inserted by mistake; but there may well be a considerable number of persons who only knew the plaintiff by sight, or have merely a slight acquaintance, who would recognize the picture at once, and would conclude that the article in fact did refer to the plaintiff, concluding (if they knew the plaintiff's name at all) that such name was merely another alias."

X PHOTOGRAPHS AS EVIDENCE

Section 44. Preliminary Proof Required. Before any writing or photograph can be introduced into evidence in the course of a trial, a foundation must be laid. Photographs in general have been held almost universally to be admissible in evidence providing they meet certain tests as to accuracy. It must be established clearly that they are true and correct photographs before they can be admitted as a part of the case and shown to a jury.

One case[110] stated, "Photographs are competent evidence, and when properly taken are judicially recognized as of a high order of accuracy. But in careless or inexpert, or interested hands, they are capable of very serious misrepresentation of the original. Before they are permitted to be used in the trial, therefore, there should always be preliminary proof of care and accuracy in the taking of them, and of their relevancy to the issue before the jury."

Such proof of accuracy may be best given by the testimony of either the photographer himself or of one who is familiar with the appearance of the person or subject at the time the photograph was taken.[111]

Section 45. Availability of Subject Matter. It must be borne in mind that photographs are only secondary evidence. Established rules of law do not permit, for instance, of the admittance into evidence of copies of an original instrument unless the original in-

[103] Merle vs. Soc. Res. Film Corp. See Footnote 88, supra.

[104] Liccione vs. Collier (1909) 133 A.D. 40, 170 N.Y.S. 639.

[105] Thayer vs. Worcester Post Co. (1933) 294 Mass. 160, 187 N.E. 292.

[106] Clarry Squire vs. Press Pub. Co. See footnote 99, supra.

[107] Peck vs. Tribune Co. See footnote 100, supra.

[108] VanWiginton vs. Pulitzer Pub. Co. (1914) 218 Fed. 795.

[109] Wandt vs. Hearst's Chic. Am. See footnote 100, supra; also Burkhardt vs. Press Pub. Co. (1909) 130 A.D. 22, 114 N.Y.S. 451; Ohmann vs. Morning Journal Assn. (1913) 209 N.Y. 582; Broderick vs. News Syndicate, 211 A.D. 1812 affd. (1926) 243 N.Y. 546.

[110] Beardslee vs. Columbia (1898) 188 Pa. St. 496, 41 Atl. 617.

[111] Brownlie vs. Brownlie (1934) 357 Ill. 117, 191 N.E. 268; Pritchard vs. Austin (1898) 69 N.H. 367, 46 Atl. 188.



This is a news picture taken for the *New York Daily News* and hung in the 7th Annual Photo Exhibit of the Press Photographers Association. Such a photograph would be legitimate evidence during a subsequent suit resulting from the wreck
Pl.cto, Joseph Costa

strument cannot be produced in court for some legitimate reason. Similarly, photographs are but copies in the sense that the scenes depicted are the real originals. Obviously enough a street intersection, for instance, cannot be brought into court, and therefore a picture of it, while secondary, is admissible. If, however, the photograph be a photograph of some subject or instrument which might be produced, then the photograph is not admissible.[112]

Section 46. Photographs of Scene or Result. As stated above, a photograph of location can be introduced into evidence if it is fair ocular representation of that place and if proper foundation for its introduction is laid.[113] If there has been a change in the appearance of a locality before the photograph was made, and if that change is a logical one which can be properly explained, the picture may be admitted into evidence. Where, for instance, the change was due to the fact that the picture was taken at a different season of the year, explanation was permitted and the photograph allowed.[114]

Section 47. Proof of Identity. Photographs are often used to prove the identity of a particular person and as such are subject to general regulations affecting the admissibility of any evidence which might be introduced for that purpose, and may be used if they meet the tests given all photographs.[115]

[112] White Sewing Machine Co. vs. Gordon (1890) 124 Ind. 495, 24 N.E. 1053; Matter of Foster's Will, (1876) 34 Mich. 21; Niller vs. Johnson (1867) 27 Md. 6.

[113] Wash. vs. Seattle (1932) 170 Wash. 371, 16 Pac. (2d) 597; N.Y.R.R. Co. vs. Robbins (1905) 38 Ind. App. 172, 76 N.E. 804; Alberti vs. N.Y.R.R. Co. (1889) 118 N.Y. 77, 28 N.E. 35.

[114] Dyson vs. N.Y.R.R. Co. (1888) 57 Conn. 9, 17 Atl. 137.

[115] State vs. Hardy (1932) 174 La. 458, 141 So. 27; State vs. Spencer (1924) 130 Wash. 595, 228 Pac. 689.

Even pictures taken from prison records have been held properly used to identify a defendant as a person having a previous record.[116]

Section 48. Proof of Paternity. New York does not permit the photograph of an alleged father in a case involving the paternity of one claiming to be his son,[117] but it must be noted that New York does not permit even the exhibit of the child himself for the purpose of proving a resemblance to his alleged father. *A fortiori*, the photograph would not be allowed to accomplish what the subject could not.

On the other hand, other States which permit proof of resemblance do allow photographs for this purpose. Where, for instance, the man who is claimed to be the father was dead, and the child was in court, a photograph of the deceased man, having been proven to be a good likeness of him, was admitted for the purpose of showing a family likeness.[118] One State even went so far as to permit a composite photograph of a man and child to be introduced as "some evidence" despite the fact that the two pictures were taken at different times and merely placed together, side by side, by a common photographic technic.[119]

Section 49. Handwriting and Typewriting Identification. Far and away the best statement, as well as the most inclusive, was made by the celebrated authority, Osborn, who wrote, "Photographs are now rarely excluded and in a number of States it is not necessary that the one who made the photographs should prove them. They can be proved by anyone competent to say that they are correct."[120]

The photograph, of course, must be shown to be fair and accurate, as well as truthful representation of the handwriting or typewriting in question.[121] There are some jurisdictions which have excluded photographs for the purpose of identifying handwriting or typewriting as, for instance, one decision which stated, "photographers do not always produce exact facsimiles of the objects delineated, and however indebted we may be to that beautiful science for much that is useful as well as ornamental, it is at least a mimetic art, which furnishes only secondary impressions of the original, that vary according to the lights and shadows which prevail while being taken."[122]

Section 50. Explanation by Experts. Often a picture itself, especially when of a scientific nature, is of little value to a court or jury unless that photograph is properly explained by an expert on the particular subject involved. Where the testimony of an expert would be of no appreciable aid to the court or jury, or where the photograph is offered only to represent visible objects or persons therein, no expert is required to explain the picture, and such testimony, therefore, is not permitted.[123]

On the other hand, where photomicrographs of knife cuts in two pieces of wood were introduced for the purpose of showing that the cuts were made by the same knife blade, an expert's testimony was necessary and desirable, and hence permitted.[124] Similarly, photomicrographs to show the size and character of a wound also required expert explanation.[125] X-rays always require such expert testimony, invariably of a medical nature, and such testimony is allowed.[126] Scientific photographs in general may be explained, or else they are meaningless to a lay jury.[127]

Section 51. Motion Pictures as Evidence. American jurisdictions seem well divided on whether or not a motion picture can be exhibited to a court or jury as evidence in the

[116] State vs. Smith (1929) 128 Ore. 515, 273 Pac. 323.
[117] Re: Wendell (1933) 146 Misc. 260, 262 N.Y.S. 41.
[118] Shorten vs. Judd (1895) 56 Kans. 43, 42 Pac. 337; See also Sheehan's Estate (1891) 139 Pa. 168, 20 Atl. 1003.
[119] In Re: Jessup (1889) 81 Cal. 408, 22 Pac. 742.
[120] Osborn, "Questioned Documents" P. 48; See also Green vs. Terwilliger (1892) 56 Fed. 384, affd. 761 Fed. 423, 15 U.S. App. 488; People vs. Mooney (1901) 132 Cal. 13, 63 Pac. 1070; Moncurris West. Life Ind. Co. (1921) 269 Pa. 213, 112 Atl. 476.
[121] Re: Hayes (1913) 55 Col. 340, 135 Pac. 449; Corbet vs. Union Dime Savings Inst. (1910) 67 Misc. 175, 122 N.Y.S. 268.
[122] Tome vs. Parkersburg Branch R. Co. (1873) 39 Md. 36, 17 Am. Reporter 540.
[123] Com. vs. Tucker (1905) 189 Mass., 457, 76 N.E. 127.
[124] State vs. Clark (1930) 156 Wash. 543, 287 Pac. 18.
[125] People vs. Ellmore (1914) 167 Cal. 205, 138 Pac. 989.
[126] Judejko vs. Chic. City R. Co. (1911) 166 Ill. App. 140; Stamets vs. Wilson (1928) 89 Ind. App. 403, 164 N.E. 300; Whipple vs. Grandchamp (1927) 261 Mass. 50, 158 N.E. 270; Marion vs. B. G. Coon Constr. Co. (1915) 216 N.Y. 178, 110 N.E. 444.
[127] U.S. Ship. Bd. vs. Ship St. Albans (Eng. 1931) A.C. 632.

case. Many States have hedged on the question and have let the matter rest in the discretion of the presiding judge.[128] Other States have excluded motion pictures, one decision stating that it is improper to "produce photographic representations of *tableaux vivants*, carefully prepared by the witnesses to present a certain version."[129]

On the other hand, a sound motion picture of a defendant's confession was held admissible in evidence in still another State.[130]

APPENDIX

RELEASE FORM TO BE SIGNED BY MODEL

(Place and date)

In consideration of the sum of $1.00 to me in hand paid, receipt of which is hereby acknowledged, I do hereby consent to the sale, reproduction and/or use of my photograph by John Jones in all manners, including advertising, trade, display, exhibition and art purposes.

I further consent to the use of my photograph by any nominee or designee of John Jones, including any publisher, agency or client, and such picture of me may be used for all of the aforesaid purposes, without any limitation or reservation.

.....

SIGNATURE

.....

WITNESS

OBJECT CLAUSE FOR CORPORATION

The objects and purposes of this corporation shall be:

1. To conduct, engage and participate in a general photographic business including the purchase, manufacture and/or sale of all material, cameras, enlargers and all other equipment, supplies, apparatus, machinery, chemicals and all other articles used in, or necessary for, the operation of such a photographic business, or any phase thereof, and to sell the same or any parts thereof or any products made therefrom, and generally, to deal in photographs, prints, pictures, enlargements, engravings and all other works of art and further, to deal in all of the supplies, publications, books and other periodicals used by photographers in connection with photography.

2. - - - - - - - - - - ***

*** There should be inserted here all other general purposes necessary for the operation of any corporate business.

LEICA CAMERAS. The Leica camera was the first modern miniature and is in large measure responsible for the popularity of miniature camera photography. The first Leica was made in 1914 by Oskar Barnack, designer in the Leitz Microscope Works of Wetzlar, Germany. He had originally made it for testing motion picture strips.

The Leica comes in the following models:

Standard Model (E): Least expensive, speeds of 1/20 to 1/500 second, no builtin-range finder.

Model II (D): Like Standard, but has built-in range finder.

Model III (F): Speeds of 1 to 1/500 second.

Model IIIb: Close view and range finder eyepieces speeds up to 1/1000 second.

All Leicas are of metal construction with cloth focal plane shutter and camera body



LEICA-MOTOR. As many as two pictures per second in automatic sequence may be taken with this device, shown attached to the base of the Leica IIIb

[128] State, Chima vs. United R. & E. Co. (1932) 162 Md. 404, 159 Atl. 916; DeCamp vs. U.S. (1926) 56 App. D.C. 119, 10 Fed. (2d) 984; Mass. Bond & Ins. Co. vs. Worthy (1928)—Tex.—9 S.W. (2d) 388.

[129] Fore vs. State (1898) 76 Miss. 727, 23 So. 710; Gibson vs. Gunn (1923) 206 A.D. 464, 202 N.Y.S. 19, affd. (1924) 208 A.D. 745, 202 N.Y.S. 927.

[130] Com. vs. Roller (1930) 100 Pa. Super. Ct. 125.

TABLE I. INTERCHANGEABLE LEICA LENSES

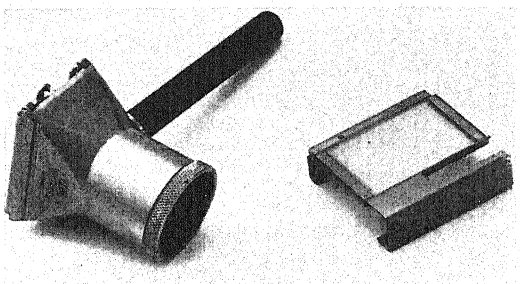
Lens	*Focal length in mm*	*Full aperture*	*Angle of field*	*Scale of reproduction compared with standard (50mm) lens*
Leitz Hektor, extra wide-angle lens.	28mm	f/6.3	76°	0.56X
Leitz Elmar, wide-angle lens.....	35mm	f/3.5	65°	0.7X
Leitz Elmar, standard lens in collapsible mount.....	50mm	f/3.5	48°	1X
Leitz Summitar, rapid lens in collapsible, rectilinear focusing mount.....	50mm	f/2	48°	1X
Leitz Xenon, ultra-rapid lens in rectilinear focusing mount.....	50mm	f/1.5	48°	1X
Leitz Hektor, rapid lens of slightly greater focal length.....	73mm	f/1.9	34°	1.5X
Leitz Elmar, long-focus portrait and landscape lens.....	90mm	f/4	27°	1.8X
Leitz Thambar, soft-focus distance lens for portrait and landscape work.....	90mm	f/2.2	27°	1.8X
Leitz Hektor, distance lens of high definition.....	135mm	f/4.5	19°	2.7X
Leitz Telyt, telephoto lens.....	200mm	f/4.5	12°	4X
Leitz Telyt, telephoto lens.....	400mm	f/5	6°	8X

measuring 1⅛ x 2⅝ x 5¼ inches. They use regular 35mm perforated film. All have a single knob which winds the shutter, transports the film, and counts the exposure in one motion.

Lenses. There are 11 interchangeable lenses for the Leica (see Table I). The standard focal length is 50mm and, with the exception of the two telephoto lenses, all Leica lenses couple with the built-in range finder. All have a depth of field scale and, except for the 28mm and 35mm lenses, all have infrared markers. Discontinued Leica lenses are the Elmar 105mm f/6.3, Hektor 50mm f/2.5, and Summar 50mm f/2—but many of these are still available in new or like-new condition.

Special Accessories. A special Leica model is the 250-Exposure Model which has an extra large film chamber holding 33 feet of film at one loading. Special camera parts are also available which turn the Leica into a camera gun (see *Camera Gun* article) or it can, with the addition of the Leica-Motor, take fully automatic sequence exposures at the rate of two per second.

The special Leica accessories, actually, are far too numerous even to list, as they number well over 500. Among the accessories provided for the camera are: Sliding Focusing



LEITZ NEGATIVE VIEWER. Here is one of the many Leica accessories—a negative viewer and notcher

Copying Attachment for close-up and copy work, extension tubes for the same purpose, Rotating Focusing Copying Attachment, or the Micro Ibso Attachment for microscopic work. The provisions for copying and photomicrographic work and for projection are numerous. For the darkroom there are the various Leitz enlargers, the Eldia printer, developing tank, negative viewer, paper holder, and negative file.

Besides these special accessories, there are camera attachments such as sunshades, filters, cases, and similar articles. Also an angle-view finder, universal finder, stereo attachment, panorama attachment. Leica also makes the Model VII Synchronized Flash Unit.

Development of the Leica. The Leica introduced to photography many innovations in camera features and design—besides the original 35mm idea. It was the first to use the range finder and also to couple a built-in range finder with the lens. It was the first camera to be constructed so that the shutter is wound and film advanced through a single action. Its manufacturer was the first to introduce the collapsible barrel mount and has done extensive research in the accessory line.

The Leitz Works originated from the small optical workshop of H. Kellner, founded in Wetzlar in 1849. After the death of Kellner in 1865, Ernst Leitz took over the business. Originally employing ten men, Leitz now employs thousands. For years E. Leitz Inc. has been one of the world's largest and outstanding manufacturers of microscopes, binoculars, etc. In placing the Leica on the market, Leitz introduced into this camera the same optical and mechanical precision embodied in a fine microscope.

LENS OPTICS AND LENS TYPES

A very brief description of lens optics and types of objectives, this article supplements the two following on *Lenses* and *Lenses and Their Characteristics*. It covers the principle of the lens, lens aberrations, the normal, wide-angle, and telephoto lens, and other special lenses. Some of the better-known lenses are listed for those who want extra ones for their cameras.

See Also Cameras, Circle of Confusion, Focal Length, Lenses, Lenses and Their Characteristics, Lenses For Amateur Movies, Shutters

THE SIMPLEST CAMERA is the pinhole camera. With this, light enters the small opening and forms a somewhat imperfect image on the film without the help of any lens whatever. The purpose of a lens is to make that image formation more satisfactory by making the rays from a point source of light reform in a point on the film.

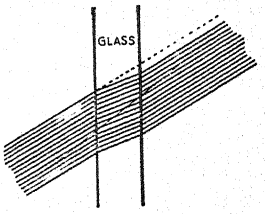


FIG. 1. When light falls at an angle on a plane sheet of glass, refraction at one surface is cancelled by opposite refraction on the other surface

PRINCIPLE OF THE LENS

A ray of light which falls at an angle on a glass surface is bent or refracted—just as light is bent when entering water. This refraction increases with the angle at which the ray falls onto the lens. With a flat sheet of glass, the refraction at one surface is cancelled by an opposite refraction at the other. Rays admitted to the glass area, in other words, will come out the other side parallel to the line of admission (Fig. 1). But with a prism, the ray is bent at both surfaces and emerges at an angle to its initial direction (Fig. 2). The amount of deflection depends on the angle of the prism. For more on refraction, see page 769.

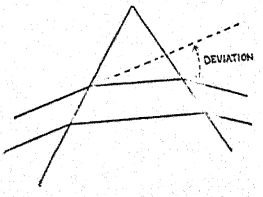


FIG. 2. How a ray of light is deviated in passing through a prism

A lens is a piece of glass with one or both faces curved and it may be considered to act like a number of small prisms of different angles. Any ray falling on the lens will be

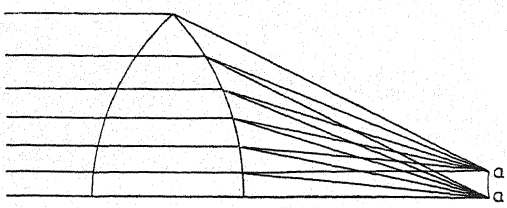


FIG. 3. When rays of light pass through a convergent lens they deviate inwards to a focus as shown here. A divergent lens has the opposite effect

deviated, but the component rays in a beam of light will be deviated by different amounts. Thus, in a theoretically perfect lens, all rays from a single point of light will come together at a point behind the lens called the *focus* (Fig. 3). When the point from which the rays come is very distant (infinity), the focus to which they are brought by the lens is called the principal focus. And the distance from the optical center of the lens to the principal focus is called the focal length. (This is not a precise definition. For more, see page 1858.)

SINGLE LENSES

Lenses may be convergent (positive) and divergent (negative) (Fig. 4). The former causes rays of light to converge or come together to a focus, while a divergent lens causes them to spread out or diverge. These divergent lenses are thus of no photographic use alone, but are used in combination with convergent lenses to correct aberrations. Surfaces may be plane, convex, like the outside of a rubber ball, or concave, like the inside of a ball. According to its form, a convergent lens may be plano-convex, double-convex, or convexo-concave (meniscus). A divergent lens may be plano-concave, double concave, or concavo-convex (also meniscus).

Lenses vary not only according to shape, but also according to composition. Some are made of flint glass of various kinds, some of crown glass, and some of quartz. These optical materials vary in their ability to refract light (index of refraction), and in their color dispersing properties.

LENS ABERRATIONS

In most discussions of lens optics it is assumed that the lens produces a perfect image. This is not true and, in fact, there are six general types of lens imperfections or aberrations. These aberrations are corrected by combining a number of components in a lens. By using two components we can correct spherical and chromatic aberration and, with the aid of a small stop, astigmatism. Three separated components are the minimum for full correction and even then there are aberrations of a higher order. The famous Tessar group has four lens parts and some, like the Turner-Reich Convertible, have two components of five elements each.

Chromatic Aberration. White light is made up of different colors and, when light is refracted, each color is refracted differently so that the colors are sorted out (Fig. 5). This is known as dispersion. Dense crown glass, for instance, has an index of refraction of 1.59 for blue-violet light and 1.57 for red light. This phenomenon gives rise to the brilliant colors seen in a diamond or a prism. Since the focal length of a lens depends on its refracting properties, a lens focuses the different colors in different planes, and color fringes are seen around the images formed by uncorrected lenses.

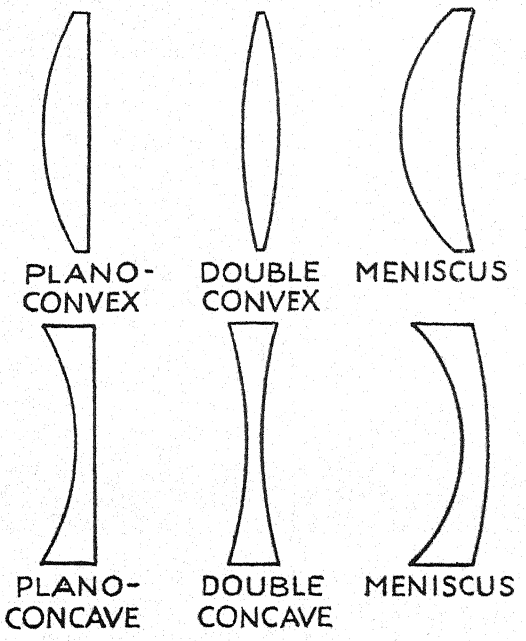


FIG. 4. Convergent or positive simple lenses are shown above. From left to right they are: plano-convex, double convex, and meniscus. Below are the divergent or negative lenses: plano-concave, double concave, and meniscus. Notice that the latter are thicker at the edges, while the former are thick at the center

A lens which is corrected for chromatic aberration by bringing together the yellow and blue-violet rays is called an *achromat* and all photographic lenses—except the simple meniscus and periscopic lenses—should be achromats. In modern photographic work with panchromatic and color film, however, a higher color correction is needed. This is especially true of detailed close-up process work, and lenses more highly corrected for chromatic aberration and equal image size in all colors are called *apochromats*.

Spherical Aberration. In the case of some lenses—especially short-focus single lenses where the sphericity of the lens is pronounced—it may be found that no amount of focusing will give a sharp image all over. This defect may be spherical aberration and is caused by the rays through the margins of the lens coming to a focus either nearer to or farther from the lens than the central rays.

In the case of some soft focus lenses a certain amount of spherical aberration is allowed to remain, but most lenses are corrected for the defect by combining a convex with a concave lens. The two lens elements (positive and negative) give opposite types of spherical aberration which neutralize one another.

Coma. This aberration is due to the unequal magnifying powers of different zones of the lens. It is really a type of lateral spherical aberration which results in an asymmetrical image of a luminous point somewhat resembling a comet or water drop. Actually, coma is not evident in the usual lens as it is usually well corrected. But it may be quite pronounced in special work—the photography of stars, for instance.

Astigmatism. Astigmatism is a defect characterized by the inability of a lens to bring together at a common focus both radial and tangential lines in the field. In most photographic objectives, astigmatism has been eliminated completely at one obliquity, and there may be slight residuals of astigmatism in other obliquities. Such lenses are therefore called *anastigmats*. The correction of astigmatism is accomplished by the use of suitably shaped positive and negative elements in the lens.

Curvature of Field. The image of a flat object should be thrown by the lens in all-over sharp focus onto the camera film or plate. This is often not the case, however, with lenses having a curved field, where the outer parts of the image are brought to a focus slightly in front of or behind the central area. Such a lens throws an image which would be in complete focus only on a saucer-shaped surface. On a flat plate or film there is falling off in sharpness toward the outside margins. Curvature may be partially remedied by stopping down. Curvature of field is different from spherical aberration. Softness occurs in the latter case because of a different focus occurring between marginal and central rays of the same beam, while the curvature softness results from a different focus occurring between axial and oblique rays which pass through *the same lens area*.

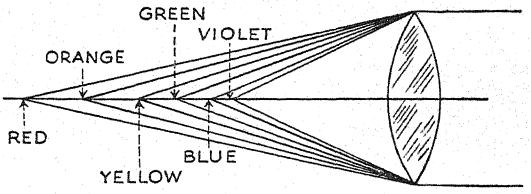


FIG. 5. When light is refracted, the spectral colors are separated and a single lens focuses the different colors in different planes. This defect, known as chromatic aberration, is usually corrected by combining a crown lens with a flint lens

Curvilinear Distortion. If a rectangular subject like a window pane is focused on the screen of a camera fitted with a single lens, it will occasionally be found that straight lines in the outer parts of the field are slightly curved (Fig. 6). This is curvilinear distortion. When the diaphragm is in front of the lens, the sides curve outward and "barrel distortion" is the result; if the stop is behind the lens, the sides are curved inward and "pincushion distortion" results. The defect is partially cured by putting the stop between lens elements.

Flare. Lens flare, not strictly an aberration, is shown by a circular patch of light near the center of the image and results from internal reflections on the glass-air surfaces of compound lenses or inside the lens mount.

CHOICE OF LENS

There is no such thing as a perfect lens. At best, a lens represents a compromise adjust-

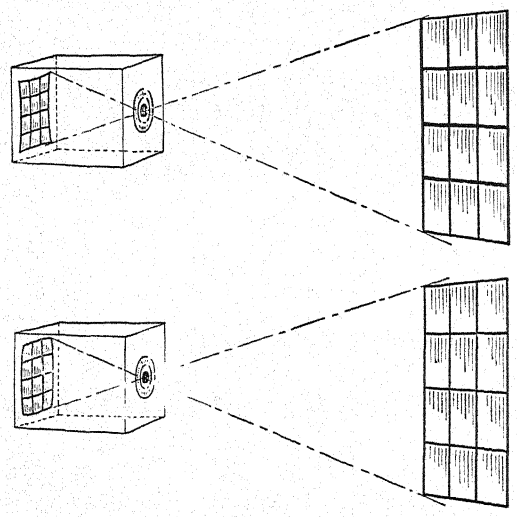


FIG. 6. In a single-lens camera curvilinear distortion occurs, causing horizontal and vertical lines to curve. If the stop is behind the lens, the curves are inward, as above; if it is in front of the lens, barrel distortion results, as below

ment of the various aberrations. The so-called normal lens is moderately well corrected on all counts. Other special lenses, however, give extreme sharpness and detail, others are built primarily for speed, a third may be useful because of the wide angle of view which it takes in, while softness will be achieved in the pictorialist's lens by allowance of slight spherical aberration. Photographers using color film, on the other hand, will need elimination of chromatic aberrations. The photographer must choose his lens or lenses carefully with these limitations in mind.

Cameras are sold today in three forms: with one permanent lens, with provision for accommodating several special interchangeable lenses, and with lensboard or other form of lens holder to take a wide variety of lenses. For the owners of the first type—box cameras, folding roll film cameras, and many miniatures come under this category—the problem of choosing a lens is inevitably bound up with the problem of choosing the camera with all its other features. The average "normal" lens for this type of camera—if there is one—has speeds from about f/4 to f/16, a focal length predetermined by the film size, and an angle of view of about 50°. Most of these lenses are anastigmatic and they are fairly satisfactory for average use. The survey of cameras beginning on page 577 will list most of the better permanent-lens cameras.

For the more advanced photographic worker, however, a variety of separate lenses is available. The most notable special need is for a wide-angle lens and a telephoto lens. Miniatures like the Contax, Leica (Fig. 7), and Ektra have screw-in lenses particularly built for close-up, wide-angle, telephoto, and other special work (for lists, see articles on *Contax*, *Ektra*, and *Leica*). Larger miniatures like the Kodak Medalist, reflex cameras such as the Graflex, Praktiflex, and Kine Exakta, or filmpack cameras like the Speed Graphic, Kodak Recomar, Ideal B, Makina IIS, and Bee Bee A—all are built for use with several different lenses. And view and studio cameras are seldom automatically sold with lenses, as interchangeable lensboards make any number of lenses available to them.

It would be next to impossible to provide an adequate survey of all available separate lenses, since there are so many makes and so many varieties within each make. The famous Zeiss Tessar lens, for instance, comes in some 50 models—with focal lengths ranging from $\frac{5}{8}$ inch to 14 inches, negative field ranging from $\frac{1}{4}$ x $\frac{1}{2}$ to 8 x 10 inches, and speeds of from f/2.7 to f/6.3. The photographer who wants to buy a separate lens should get advice from the camera manufacturer or his local photographic dealer. Each make of camera presents a special problem of type of shutter and lens mount, for instance.

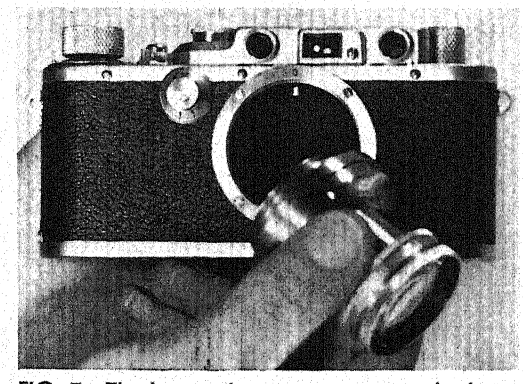


FIG. 7. The lenses of many cameras, as the Leica shown above, are removable. This makes a more versatile instrument out of the camera, as a wide choice of lenses is then open to the photographer



FIG. 8. Here is an experiment with lenses, using 5 x 7 film. Top left is a normal photograph, taken with an 8¼ anastigmat at f/32 and bottom left is the same set-up with a magnifying glass used in place of the lens. At the right are two pictures taken with a 6-inch lens too short for the 5 x 7 film used. Below is an exposure at f/4.5, showing marked vignetting, and above is an improvement, when the lens was used at f/32
Photos, Alexander Alland

In general, however, this can be said. The higher the speed and the longer the focal length, the higher will be the cost. The longer the focal length and the smaller the linear aperture of the lens, the greater will be the depth of field. Also the longer the focal length of the lens, the greater is the *relative* image size and the smaller is the angle of view. Remember, too, that speed has nothing to do with quality.

TYPES OF LENSES

Normal Lenses. For a normal lens, the focal length should be approximately equal to the diagonal of the desired picture size (Fig. 8). Here is a sample table:

Picture Size (Inches)	*Picture Diagonal (Inches)*	*Picture Diagonal (mm)*
2¼ x 2½	3.36	85
2¼ x 3¼	3.95	100
3¼ x 4¼	5.35	130
4 x 5	6.4	163
5 x 7	8.6	218

The actual focal length of a lens (numerically), then, has nothing to do with its so-called "normalcy." For one camera, that is, a 100mm lens may be normal, for another it will be short, and for a third it may produce a telephoto effect. The best known average lenses—each one coming in many focal lengths and speeds—are the Bausch & Lomb Tessar, Cooke Anastigmat, Goerz Dagor, Kodak Ektar, Leitz Summitar, Schneider Xenar, Wollensak Velostigmat, Zeiss Tessar (Fig. 9), and several others.

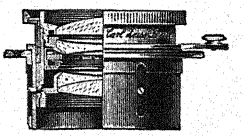


FIG. 9. Zeiss Tessar lens

Wide-Angle Lenses. A wide-angle lens is a lens covering an angle of view of more than about 55°. It is a lens having a focal length shorter than normal—as "normal" has been defined above. It is used particularly in architectural work or newsphoto work where a wide subject range must be covered from close up. Wide-angle lenses extend the field to anywhere from 60° to 100°, although

there is one, the Robin Hill (see article on *Hill Camera*), which has an angle of almost 180°. Wide-angles include the Bausch & Lomb Protar Wide Angle, Goerz Super-Dagor Wide Angle, Leitz Hektor 28mm, Meyer Aristostigmat Extreme Wide Angle, Wollensak Wide Angle, and the Zeiss Tessar Wide Angle.

Telephoto Lenses. A lens of longer-than-normal focus is commonly known as a telephoto lens. However, the term "telephoto" strictly refers to a special construction with a widely separated positive and negative element whose optical center lies *in front of* the lens itself (see article on *Focal Length*). The camera extension is thus quite short compared with the focal length. This type of lens is useful for obtaining close-up views of relatively distant objects. The angle of view covered is around 30° and less. Some well-known telephoto lenses are the Dallmeyer Dallon (of which there are some 11 models), the Goerz Telegor, Ilex Teletar, Leitz Telyt, Plaubel Tele-Makinar, Schneider Tele-Xenar, and Zeiss Tele-Tessar.

Portrait Lenses. For portraiture a lens of considerable focal length and large aperture is helpful. It is also good to get these with some means of softening the sharpness of the image. A favorite for many years has been the Petzval lens, but this is not anastigmatic and therefore must be used stopped down if all-over definition is desired. Modern portrait lenses still available are, for instance, the Cooke Home Portrait Lens, Dallmeyer Patent Portrait, Ilex Photoplastic, and Ross Rapid Portrait.

Process Lenses. These lenses are used by photoengravers and other photographers who must have the finest definition possible to get a plane image from a plane object. These are often of great focal length, since so much unit magnification copying work of large prints must be done, and they are usually as slow as f/11 or f/16. These lenses must be particularly free from distortion and lateral chromatic aberration, and examples are the Bausch & Lomb Apochromat Process, Cooke Process Apochromatic VB (9 models), and the Wollensak Velostigmat and Apo-Tessar Process.

Soft Focus Lenses. Many pictorialists have found that slight softening of the image is better accomplished by a soft focus lens than by other diffusion devices—such as diffusion discs over the normal camera lens or enlarger lens. The softening effect is usually accomplished by a slight lack of spherical aberration correction and in many of them the degree of diffusion is controllable. Many of the portrait lenses are also soft focus. Among soft focus lenses are the Leitz Thambar, Bausch & Lomb Plastigmat, and the Wollensak Verito. The latter yield any degree of softness by changing the diaphragm aperture opening.

Enlarger Lenses. In many cases, ordinary camera lenses may be used also on the enlarger. There are certain objections, however, not the least of which is the undue heat to which the camera lens may be subjected in some enlargers. A regular lens, too, is designed for use with comparatively distant objects and it is usually corrected for yellow and blue light; the enlarger lens, on the other hand, must pass light of the blue and near ultraviolet region to which bromide paper is particularly sensitive and it must work at linear enlargements of 2 to 15 times. Therefore many lens makers put out special enlarger lenses with high chromatic correction —especially good for making separation negatives. Among these are the Wollensak Enlarging Velostigmat and Leitz Varob. The Bausch & Lomb Micro Tessar and Kodak Anastigmat are also especially suited to enlarging work. In general, enlarger lenses do not differ much from camera lenses.

Supplementary Lenses. Supplementary lenses are simple lenses which are placed in front of the normal camera lens—much like a filter. They may make the camera suitable for copying or close-up portrait work or they may convert the ordinary camera into an instrument for telephoto work. The portrait attachment is positive and shortens the effective focal length, while the negative attachment increases the focal length. In most cases, these supplementary lenses are used with permanent-lens cameras and typical examples are the Kodak Telek (negative) and Portra (close-up) and the special diffusion discs for soft focus work. The use of a negative attachment demands a camera with a considerable bellows extension.

Special Lenses. The most common special lens is the convertible—a type of lens which allows for the interchanging of lens elements. Examples are the Goerz Convertible Anastigmat, Bausch & Lomb Convertible Protar, Cooke Convertible Anastigmat, and Wollensak Triple Convertible Velostigmat. These are made up of two lenses joined by the shutter unit, either one of which may be used separately for long focus effects. Together the doublet makes a high speed moderate focal length lens for all-around work.

Then there are special lenses, of which the Robin Hill (see article on *Hill Camera*) is perhaps the most spectacular with its near 180° angle of view. And other special work demands special forms of correction. There are the Schneider Aero-Xenar and Zeiss Ortho-Protar for aerial survey work, as well as the Bausch & Lomb Aero lenses, and these have wide angle, moderate speed, and good flat field definition.

LENSES

D. R. Farmen

Technical Editor, Eastman Kodak Co.

Lenses are here explained for the amateur in clear and concise terms. These subjects are covered: focal length . . . use of diaphragm . . . relative aperture . . . circle of confusion . . . depth of field . . . perspective distortion . . . resolving power. The normal lens types are covered, along with wide-angle and telephoto lenses. There is also a detailed description of the use of supplementary lenses—of special interest to owners of permanent-lens roll film, box, or miniature cameras.

See Also Circle of Confusion, Depth of Field, Focal Length, Lens Optics and Lens Types, Lenses and Their Characteristics, Shutters

SIMPLY STATED, the purpose of a photograph is to make a permanent and faithful record of a scene as perceived by the eye. The starting point of such a photographic record is the latent image formed on the light-sensitive material by the camera lens. It is the purpose of this section to present a few of the principles involved in photographic optics and to tie them in with the actual mechanics of "taking a picture."

FOCAL LENGTH

The two most obvious properties of a camera lens are (1) its focal length (as marked on the lens in millimeters (mm) or inches), and (2) its relative aperture.

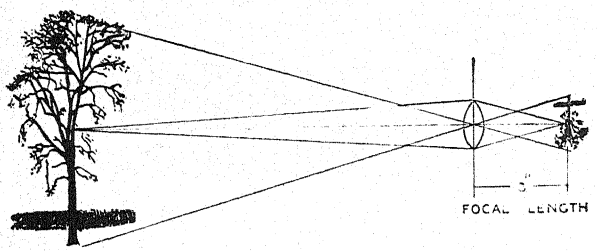
The focal length of a lens is the distance from the optical center of the lens to the image formed of an object at an infinitely great distance. Practically, the focal length of a camera lens can be easily determined by measuring the distance from the center of the lens to the film when the camera is focused for infinity. For details, see article on *Focal Length.*

The focal length of a "normal" camera lens should be approximately equal to the diagonal of the negative with which it is used. This relationship between focal length and negative size is not accidental but rather is calculated for two reasons: (1) because a focal length equal to the diagonal of the negative produces a field of view for the camera which approximates that of the eye (45° to 50°); and (2) because it is quite possible and practical for the lens designer to compute lenses which can give excellent definition over a field of this size without resorting to special formulas and lens shapes which might make the lens prohibitively expensive. (This is not entirely true of lenses used for press work. Press photographers prefer to use lenses which cover a larger angular field. To compensate for possible loss in definition or sharpness in the corners of the field it is necessary to stop the lens down.)

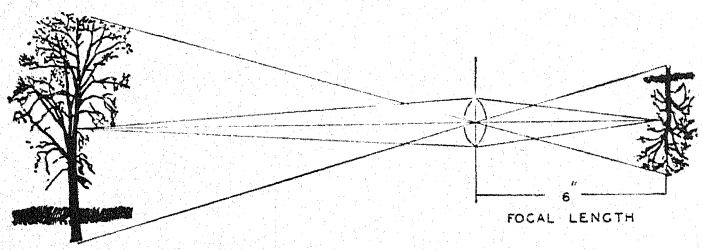
NEED FOR FOCUSING

In order to form a sharp image, lenses must be focused. To form a sharp image of a subject at an infinite distance, the camera lens must be at a distance from the film plane equal to the focal length of the lens. Thus, the focal length of the lens is a factor in the size of the camera. The focal lengths for several typical picture sizes are given below. It will be seen that the longer the focal length of the lens, the larger the picture (Fig. 1).

Approximate Picture Size (inches)	*Approximate Focal Length (inches)*
1 x 1½	2
1⅝ x 2½	3
2¼ x 3¼	4
2½ x 4¼	5
3¼ x 4¼	5⅛
3¼ x 5½	6¾



SHORT FOCAL LENGTH, SMALL IMAGE



LONG FOCAL LENGTH, LARGER IMAGE

FIG. 1. The longer the focal length of the lens, the larger the picture. This fact is shown here graphically, using a 3-inch and 6-inch lens for examples

To form sharp images of subjects closer to the lens, the lens must be moved away from the film plane. The nearer the subject to the lens, the farther the lens must be from the film plane (Fig. 2). The changes in lens-to-film distance for changes in subject distance vary but slightly when the subject is beyond 50 to 100 feet from the lens, but increase rapidly as the subject approaches the lens. This is shown by the intervals on any focusing scale. This lens-to-film distance changes more rapidly with a lens of long focal length than with a lens of short focal length. This is demonstrated by the differences in the focusing scales of a 6-inch and a 3-inch lens (Fig. 3).

In focusing a camera, less accuracy is required in focusing for distant subjects than for subjects close to the camera. At very close distances, for greatest sharpness, the distance should be measured with a measuring tape, or a range finder can be used.

USE OF THE DIAPHRAGM

The lenses on all but the simpler cameras are equipped with an iris diaphragm. In poor light the diaphragm must be opened up in order to admit enough light to expose the film properly; in bright light a smaller opening can be used.

The sharpness of most pictures is increased considerably by the use of a small lens opening. If the distance has been estimated accurately, the subject focused upon is in sharp focus regardless of the lens opening, but if a small lens opening is used, more of the subject matter in front of and behind the subject focused upon will be sharp. The use of a small lens opening may enhance the general appearance of the picture because the subject is more apt to fall within the range of sharpness even if the distance should be misjudged. This range of sharpness is called depth of field and will be discussed in greater detail on page 2267.

RELATIVE APERTURE

Modern cameras have their lens openings marked in terms of f-numbers. The f-number is the ratio between the focal length of the lens and the effective diameter of the lens opening. To find the approximate f-number of a lens, divide the focal length by the effective diameter of the lens. For example, a lens with a focal length of 4 inches with an effective diameter of ½ inch

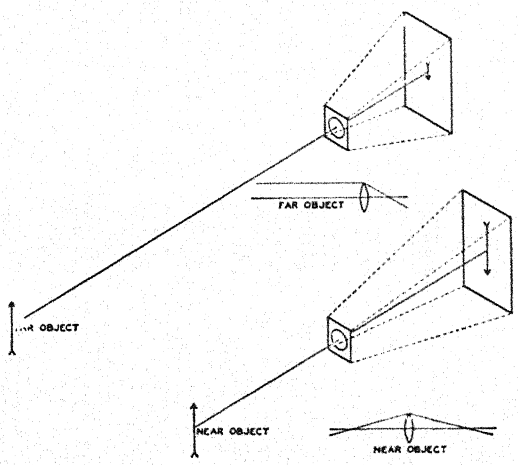


FIG. 2. The nearer the subject to the lens, the farther the lens must be from the film. Image distances for far and near objects are shown

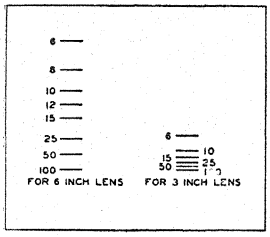


FIG. 3. The focusing scales for a 6-inch and 3-inch lens are shown. Notice that the lens-to-film distance changes more with a lens of long focal length

would have an f-number of f/8. This system of designation is useful because it is a universal measure of lens speed and is independent of the size of the camera. On small cameras f/8 permits the same intensity of light to strike the film as f/8 does on a large camera. Likewise, an f/4.5 lens stopped down to f/11 permits the same intensity of light to strike the film as does an f/11 doublet lens working at full aperture. Lenses are customarily referred to in terms of their lowest f-number (widest opening). Thus, an "f/4.5 lens" has f/4.5 as its maximum speed.

To determine the relative speed of two lenses or of the same lens working at two different f-numbers, divide the larger f-number by the smaller and square the result. For example, the relative speed of an f/3.5 lens as compared with a lens working at f/11 is $\left\{\frac{11}{3.5}\right\}^2 = 3.15^2$ or approximately 10 times

(see page 1661).

While the f-system is now in common use, until recently the "U.S." (Uniform System) markings were used on some lenses. In this system, the numbers are proportional to the exposure required, f/4 being taken as unity. Another system, until recently used with single lenses, is the 1, 2, 3, 4 system. For the relation of f-number system to U.S. System, see page 1068. The f-number system can be compared with the 1, 2, 3, 4 system as follows:

1.....f/11
2.....f/16
3.....f/22
4.....f/32

RELATION BETWEEN LENS OPENING AND SHUTTER SPEED

If, under a certain set of conditions, a lens aperture setting of f/11 and a shutter speed of 1/25 second will give a properly exposed negative, then f/8 at 1/50 second will give the same exposure. Although the shutter is open only one-half as long as at 1/25 second, the lens at f/8 admits twice as much light as at f/11. Thus the net result is the same. Likewise, f/5.6 admits four times as much light as f/11 and when used with a shutter speed of 1/100 second, will give the same exposure on the film as an exposure of 1/25 second at f/11. This principle can be applied to any f-number and shutter speed. If the shutter speed is doubled (exposure time cut in half), the next larger lens opening must be used. Conversely, if the shutter speed is halved (exposure time doubled), the next smaller lens opening must be used.

GENERAL LENS TYPES

Meniscus Lenses. The use of meniscus lenses is largely limited to fixed-focus box cameras. A meniscus lens (Fig. 4) is capable of forming a good image and because of its relatively small aperture (f/15) is particularly successful in simple cameras for snapshot purposes. Such cameras require no focusing and are intended for use outdoors, in sunlight. With fixed-focus box cameras

TYPE OF LENS	ELEMENTS OF LENS	RELATIVE SPEED
Meniscus		1
Doublet		1½
Anastigmat *f*/8.8		3
Anastigmat *f*/6.3		6
Anastigmat *f*/4.5		11
Anastigmat Special *f*/3.5		18
Ektar *f*/1.9		61

FIG. 4. The structures of some Kodak lenses are shown here. For typical examples of photographic possibilities of each lens, see Figure 6

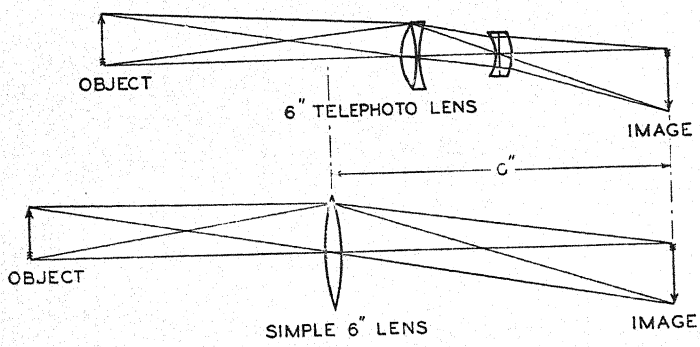


FIG. 5. Image distances for 6-inch normal lens (below) and 6-inch telephoto (above). In the telephoto system, the positive element is in front and the weaker negative element is nearest to the image

about all that is required of the operator is to center the scene in the finder and press the exposure button. Fixed-focus cameras are restricted to distant views and to subjects eight feet or more from the camera unless supplementary lenses are used. Snapshots can be made indoors at night with photoflood lamps in suitable reflectors or with photoflash lamps.

Diway Lenses. A special type of meniscus lens is represented by the Kodak Diway Lens. This lens consists of a meniscus lens with a pivoted negative front element which can be swung in front of the camera lens. With the front element swung out of the system, the lens focuses sharply all subjects from 5 to 10 feet in front of the camera. With the front element swung into the system, the camera focuses sharply all subjects from 10 feet and beyond. Kodak Diway lenses can be used at a somewhat larger aperture than simple meniscus lenses, i.e., f/12.5.

Doublet Lenses. As the name implies, doublet lenses are made of two individual lenses, which may or may not be cemented to form a single unit (Fig. 4). Doublet lenses fall in two classes. One class has a relatively short focal length (2 or 3 inches at the most) and is used on fixed-focus folding cameras. Lenses in the second class have a longer focal length and are used on cameras having focusing adjustments. Doublet lenses are usually faster (f/11) than meniscus lenses.

ANASTIGMATS

All lenses faster than about f/8 should be corrected for the aberration called astigmatism if they are to be suitable for use as photographic objectives (Fig. 4). Thus it is safe to assume that most of the faster camera lenses are corrected for astigmatism whether they are marked as anastigmats or not.

These lenses are made up of three or more elements, have maximum relative apertures from f/8.8 to f/1.5 and are called by a number of names. These lenses are used on cameras which have some means of focusing the lens. They can be expected to form sharp images of all subjects from about 4 feet to infinity when properly focused. The focusing adjustment depends upon the structure of lens and the type of camera on which it is used. Some of these lenses have front element focusing devices. That is, the front element of the lens is moved outwards to focus for subjects closer to the lens than infinity. Other lenses are focused by moving the entire lens away from the film.

TELEPHOTO AND WIDE-ANGLE LENSES

Telephoto lenses allow the photographer to obtain large images of distant objects with cine and still cameras—such as view cameras, Graflex and Speed Graphic, and certain miniature cameras—having limited bellows extensions. The angular field covered is relatively narrow, and extreme care must be exercised in using such lenses. They must be accurately focused and for best results the camera should be supported on a tripod or other support firm enough to prevent any motion of the camera during exposure.

Wide-angle lenses permit the photographer to cover a wider field of view than is covered by normal camera lenses. They are used extensively by press photographers and by commercial photographers working in limited space. For example, photographs taken in small rooms, etc., where it is desirable to show as much of the room as possible, are often made with wide-angle lenses. Both telephoto and wide-angle lenses, because of peculiarities of design, are of medium speed.

(*Continued on page 2265*)

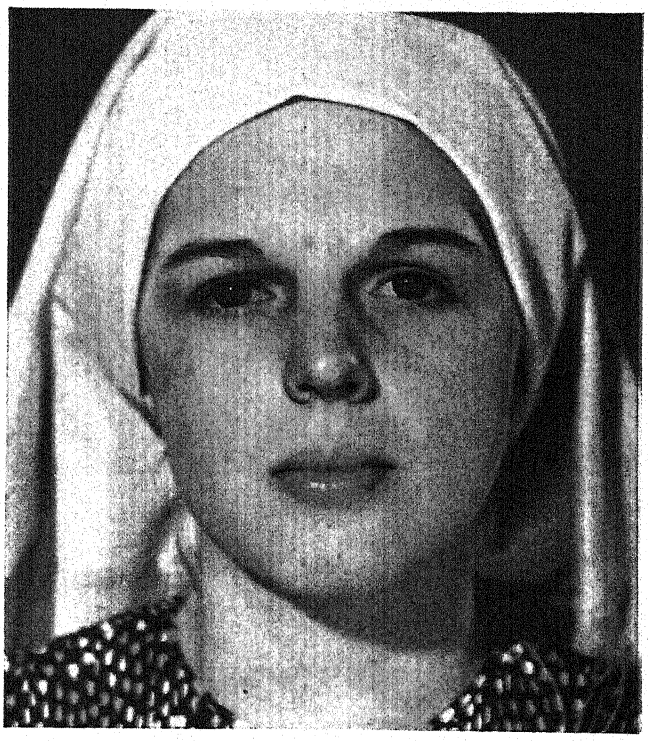


FIG. 1. This picture illustrates the first step in applying the make-up for Kodachrome photography. A head band is formed and all street make-up removed. Notice the blemishes and dark undertones



FIG. 2. When grease-paint foundation is used it is applied in small daubs. The correct shade of foundation is selected and about one-half inch removed from the tube. See article, *Make-Up For Color*

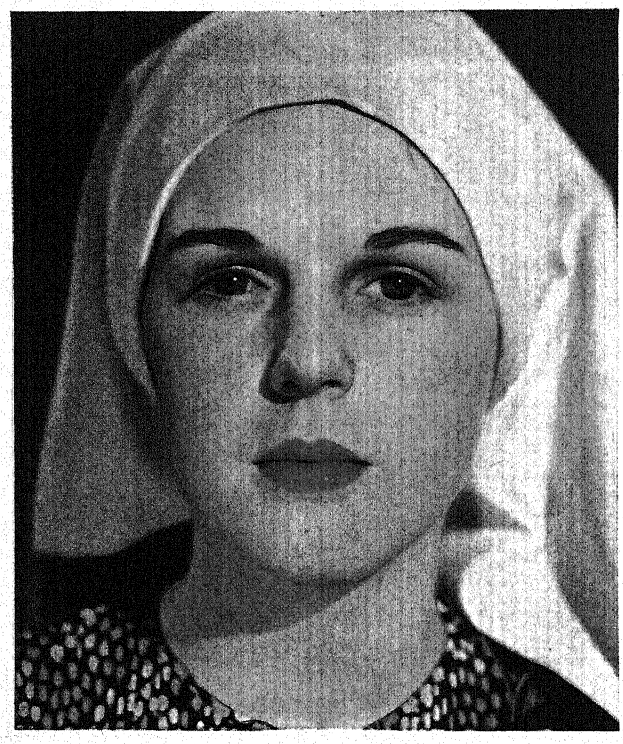


FIG. 3. The foundation is then blended, the eyebrows darkened and the lip rouge and eye shadow applied. Even though it is slight, notice the unevenness which will be corrected with powder



FIG. 4. This is the completed make-up. The powder has been applied and all traces of unevenness removed. The skin texture is now smooth and clear. Compare this picture with the one without make-up



FIG. 5. Freckles are quite common, but when the correct shade of make-up is carefully applied, they present no problem when using Kodachrome film

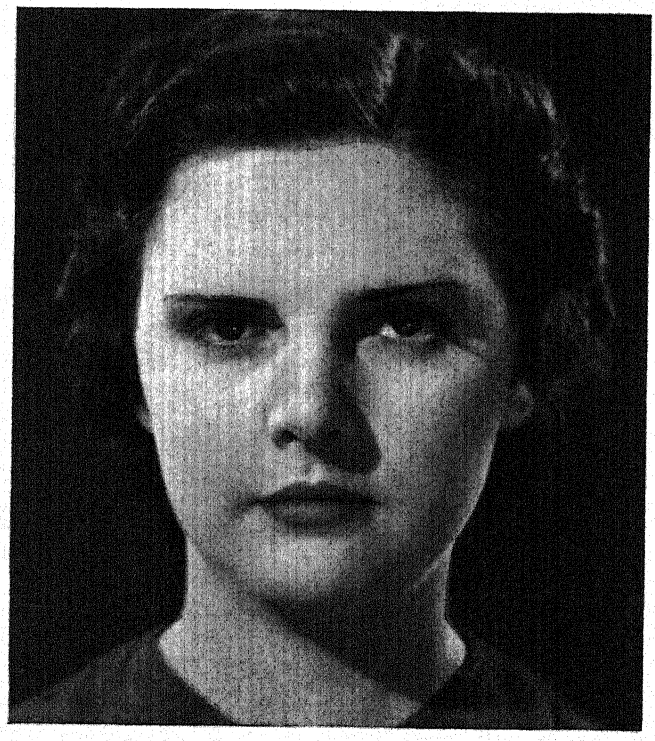


FIG. 6. The same girl photographed after make-up has been properly applied. Compare this with the picture above. See article *Make-Up For Color*



KITCHEN SCENE PAUL OUTERBRIDGE

For a complete description of the lighting set-up for this illustration for an A & P coffee advertisement, see Figure 2 in the story *Lighting and Studio Technic For Color Ads* by the photographer



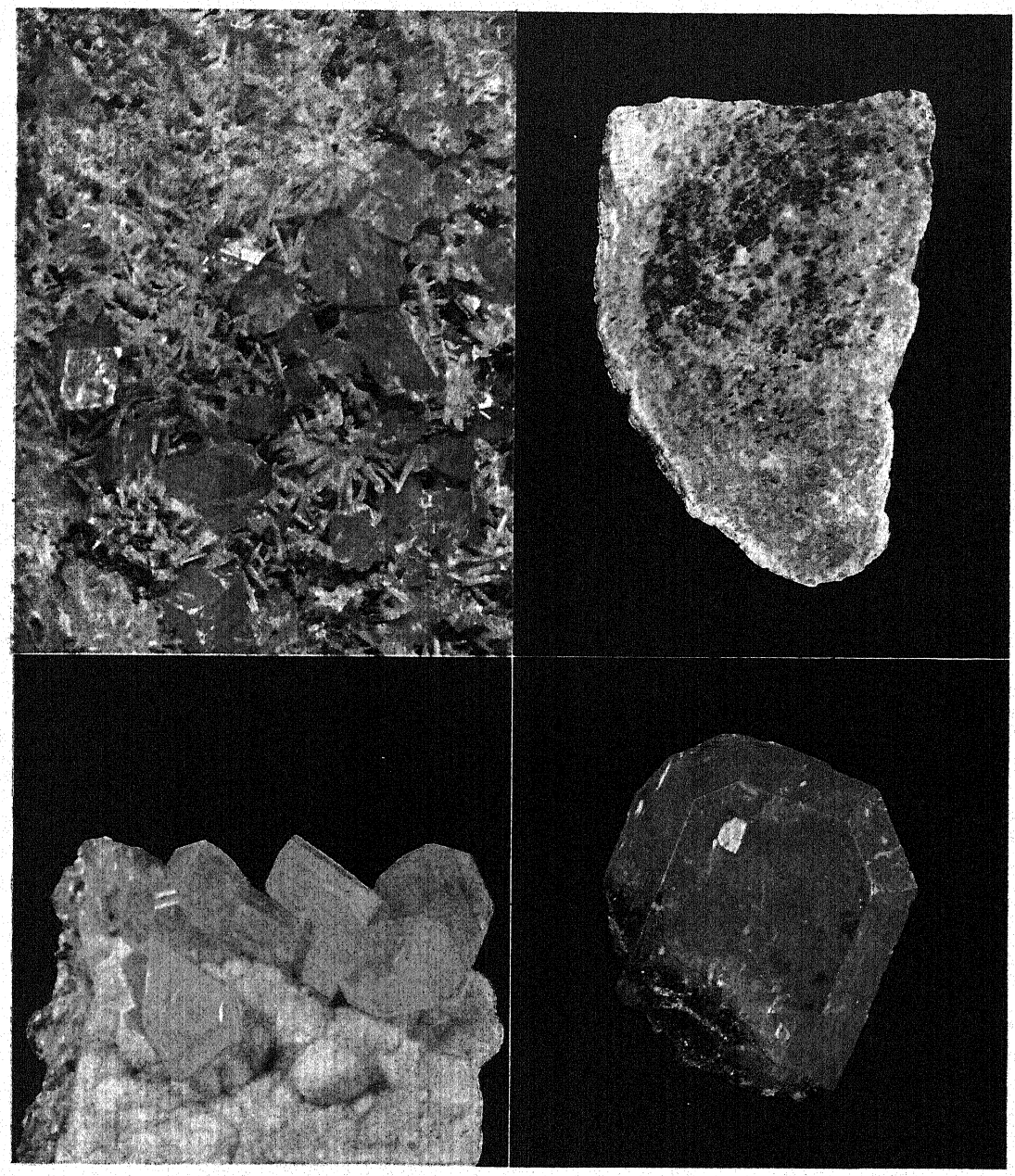
FOUR ROSES PAUL OUTERBRIDGE

This shows a still-life type of color illustration made for Four Roses whiskey used in advertising. See Figure 3 on page 2339 for lighting details



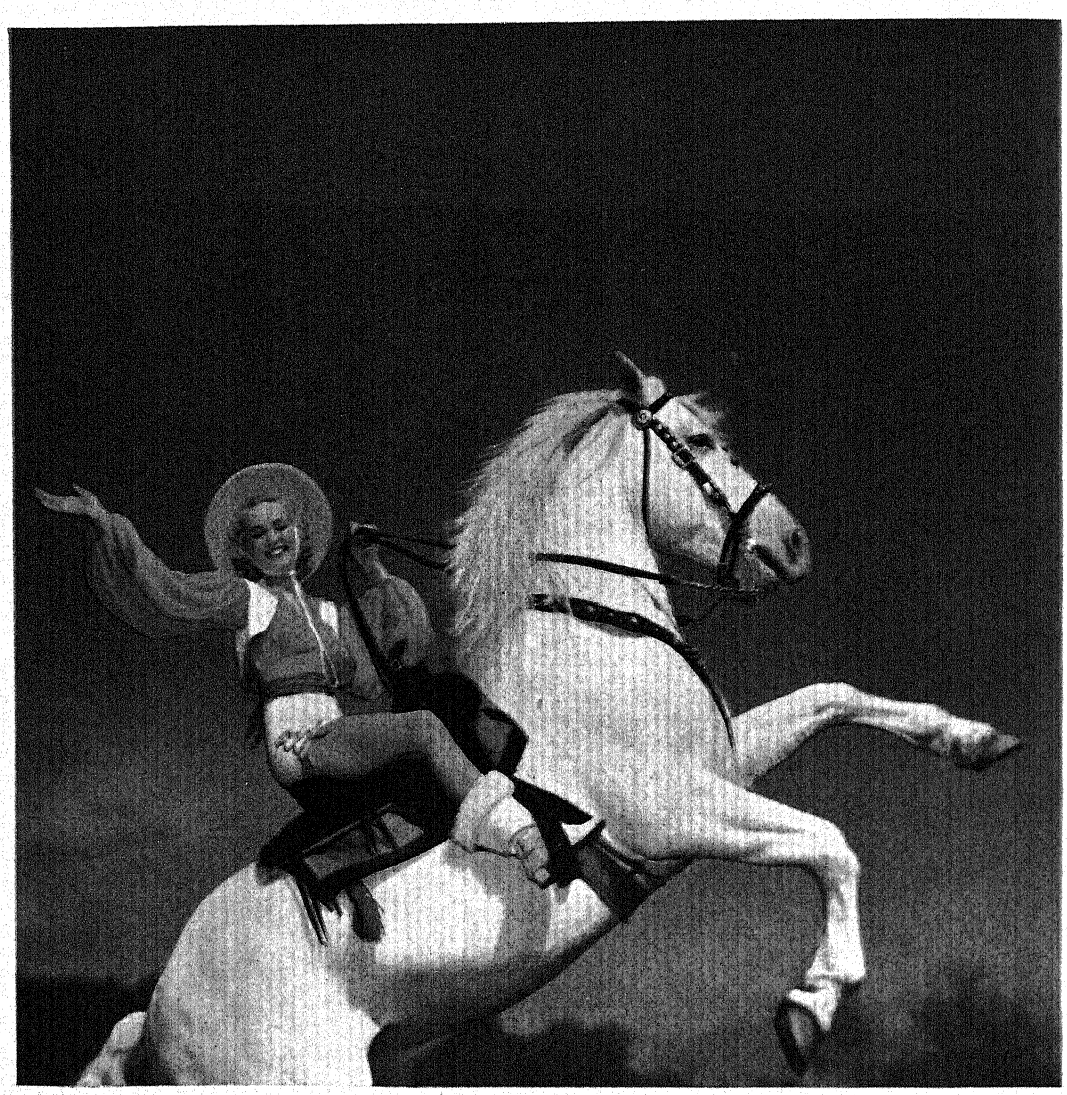
AFTER DINNER COFFEE — PAUL OUTERBRIDGE

This color close-up gives emphasis for an A & P coffee advertisement. See Figure 4 on page 2340 for detailed color lighting diagram



These color photomicrographs illustrate the article on *Mineralogy and Photography* by Mary S. Shaub. See her article for complete technic. *Upper left:* Rhombohedral crystals of Rhodochrosite from Montana. About ½ natural size. *Upper right:* Feldspar containing black grains of Uraninite many of which have altered to the orange and yellow uranium mineral, Gummite. Both minerals are a source of radium. Specimen from New Hampshire. About ⅓ natural size. *Lower left:* Crystals of sulphur from Sicily. About ⅔ natural size. *Lower right:* Tetragonal crystal of Wulfenite from Arizona. The mineral contains the metals lead and molybdenum. About 1½ natural size

(Specimens in the Harvard Mineralogical Museum Collection)



COWGIRL EARL THEISEN

This action picture shows brilliant lighting achieved by using a combination of sunlight and a daylight blue-coated flashbulb. The flash lamp gives just enough illumination in the dark shadows to bring out all the vivid colors

(*Continued from page 2256*)

Telephoto and wide-angle lenses represent two special types of lenses, designed and used to obtain two opposite effects. Telephoto lenses have a relatively long effective focal length; thus they form large images of distant subjects and cover relatively narrow angles. On the other hand, wide-angle lenses have relatively short focal lengths; thus they form small images of distant subjects and cover relatively wide angles.

A telephoto lens system consists of a pair of separated lenses, one positive and one negative (Fig. 5). The positive lens is so placed that light from the subject is converged. This converging beam passes through the negative lens which is somewhat weaker than the positive lens. The result is that the optical center of the lens is moved out beyond the positive front element. Thus the effective focal length of the lens (as measured from the optical center of the lens to the image plane) is considerably greater than the back focus of the lens (as measured from the rear lens surface to the image plane). It is for this reason that it is possible to use a telephoto system with an effective focal length of 17 inches on a camera the bellows of which accommodates a normal lens with a focal length of but 8 inches (3¼ x 4¼ Auto Graflex).

Wide-angle lenses are intended to cover larger fields of view than normal lenses. Thus, the focal length of a wide-angle lens is shorter than the diagonal of the negative size with which it is used. In producing a wide-angle lens, special attention must be given to the optical design of the lens elements and the mechanical design of the barrel and mounting in order to assure acceptable sharpness and even illumination over the entire negative.

WHAT DIFFERENT LENSES CAN DO

The picture-taking ability of a camera is governed largely by its lens. With a single meniscus lens, such as is used on inexpensive box cameras, snapshots can be taken in bright direct sunlight or in open shade. With a fast lens such as an f/3.5 or f/2.0, snapshots can be taken not only in bright direct sunlight or open shade, but also on cloudy and very dull days. The indoor snapshot possibilities with meniscus lenses are limited to portraits with photoflood lamps, etc., where the light source can be placed within 3 feet of the subject. With the faster lenses snapshots can be made indoors under existing light conditions. Figure 6 illustrates the picture-taking possibilities of some of the lens types found on modern cameras.

CIRCLE OF CONFUSION

A good lens, one which has been properly designed and manufactured, forms sharp images of points at the distance for which the lens is focused; points nearer or farther than the distance focused upon are not imaged sharply, but rather as blurred points. The farther the points are from the plane focused upon, the more blurred are the images of the points. These blurred images are called "circles of confusion." The diameter of these circles of confusion limits the depth of field of the lens. The diameter of the circle of confusion should not be confused with the diameter of a star image produced by the lens (page 2291). The circle of confusion is of no significance whatever except in depth of field considerations and it is not a measure of lens quality (see page 770).

Circle of Confusion and Depth of Field. The circle of confusion enters into the depth of field of a lens as follows: The limitations of the human eye are such that any point having a diameter of 1/100 inch or less, viewed at 10 inches or subtending 2 minutes of arc or less, appears to be a sharp point. If the image of a line is made up of points 1/100 inch in diameter or smaller, the line will look sharp. If the points making up the image are larger than 1/100 inch, the line will look blurred. The size of the points in the image are directly related to the distance of the object from the point focused on. For example, if a camera is focused for 10 feet, points 10 feet from the lens will be focused sharply on the film. Points 11 feet from the lens will be focused slightly in front of the film, and the image on the film will be slightly blurred. Likewise, the image of a point 9 feet from the lens will be slightly blurred because its image is formed behind the film. It is a relatively simple matter to calculate the distance at which points in the

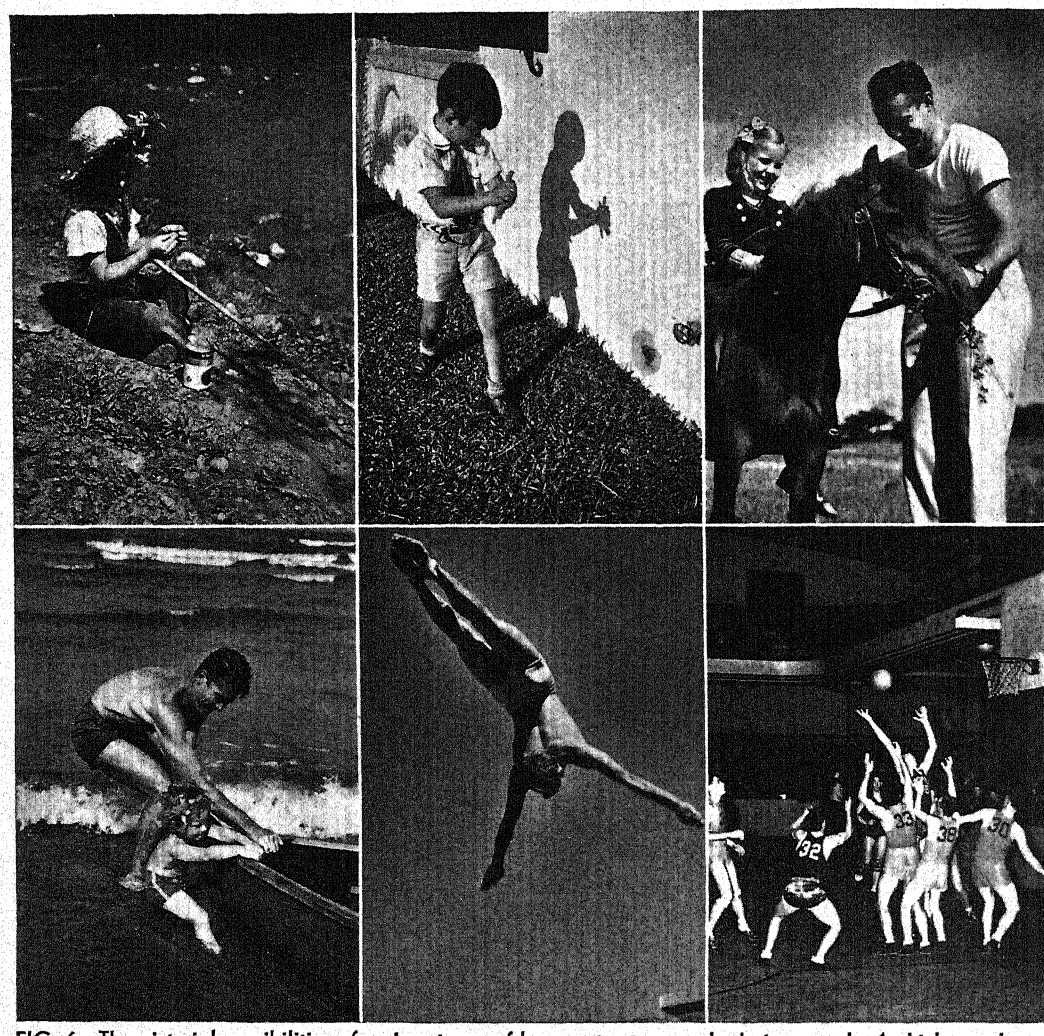


FIG. 6. The pictorial possibilities of various types of lenses, structures and relative speeds of which are shown in chart form in Figure 4 (page 2255), are illustrated in the group of photographs above. *Top row*, left to right: Meniscus, Doublet, Anastigmat f/6.3. *Bottom row*, left to right: Anastigmat f/4.5, Anastigmat f/3.5, and High Speed f/2

object space must be to form a blurred image point 1/100 inch in diameter. These calculated distances are the limits of the depth of field, and all points between the limits will be within the depth of field* and imaged apparently sharp. See page 1226.

Circle of Confusion and Print Size. Since, in the final analysis, the depth of field of a lens is a function of visual acuity and of viewing distance, it is clear that the size of the permissible circle of confusion in the negative depends to a great extent on the way in which the negative is to be used in making the final print. If a contact print is all that is desired, then a circle of confusion of 1/100 inch will appear sharp. However, if the negative is to be enlarged, a smaller circle of confusion must be chosen as the criterion of sharpness. Assuming a fixed viewing distance for the print of 10 inches, for each unit increase in print size the permissible circle of confusion is decreased by an equal factor. That is to say, if 1/100 inch is satisfactory for contact or

* The conjugate of depth of field is depth of focus. Whereas depth of field is in the object space, depth of focus is in the image space. The distance between the images of points at the near limit and the far limit of depth of field is the depth of focus. Depth of focus is sometimes thought of as the distance the film can be moved without throwing the image out of focus.

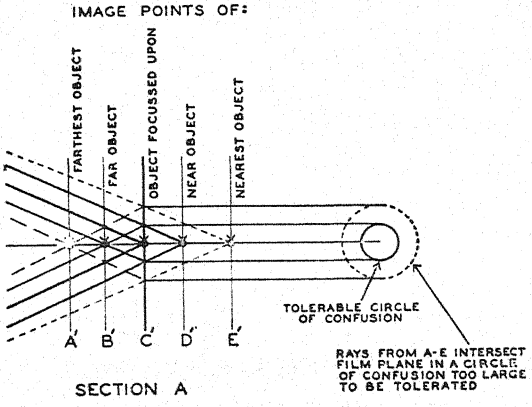
1X prints, 1/200 inch would be the maximum permissible circle of confusion *in the negative* for a 2X enlargement, 1/300 inch for a 3X enlargement, etc., if all the prints were to be viewed from a distance of 10 inches.

DEPTH OF FIELD

In considering depth of field (Fig. 7), the circle of confusion chosen for the computations may be fixed, i.e. 1/100 inch, 1/200, 1/500, 1/1000, etc.; or the circle of confusion can be a fixed fraction of the focal length of the lens. It is customary to choose a fixed circle of confusion for lenses of relatively short focal length as used on small cameras. In computing depth of field for longer focal length lenses, such as are used on view, press, and studio cameras, a relative circle of confusion expressed as a fraction of the focal length of the lens is often used.

The depth of field depends upon the relative aperture at which the lens is used, the focal length of the lens, and the distance focused upon. *The depth of field increases as the aperture of the lens is decreased because the size of the pencil of light leaving the lens decreases as the aperture is decreased.* Here, a point near the lens is imaged so far behind the film plane that, at full aperture, the circle of confusion is too large to appear to the eye as a point. This point then appears out of focus. Decreasing the aperture decreases the size of the circle of confusion and if the aperture is reduced far enough, the circle becomes small enough to appear as a point. Thus, then, reducing the aperture increases the depth of field.

Depth of Field and Focal Length. Depth of field increases as the focal length decreases.



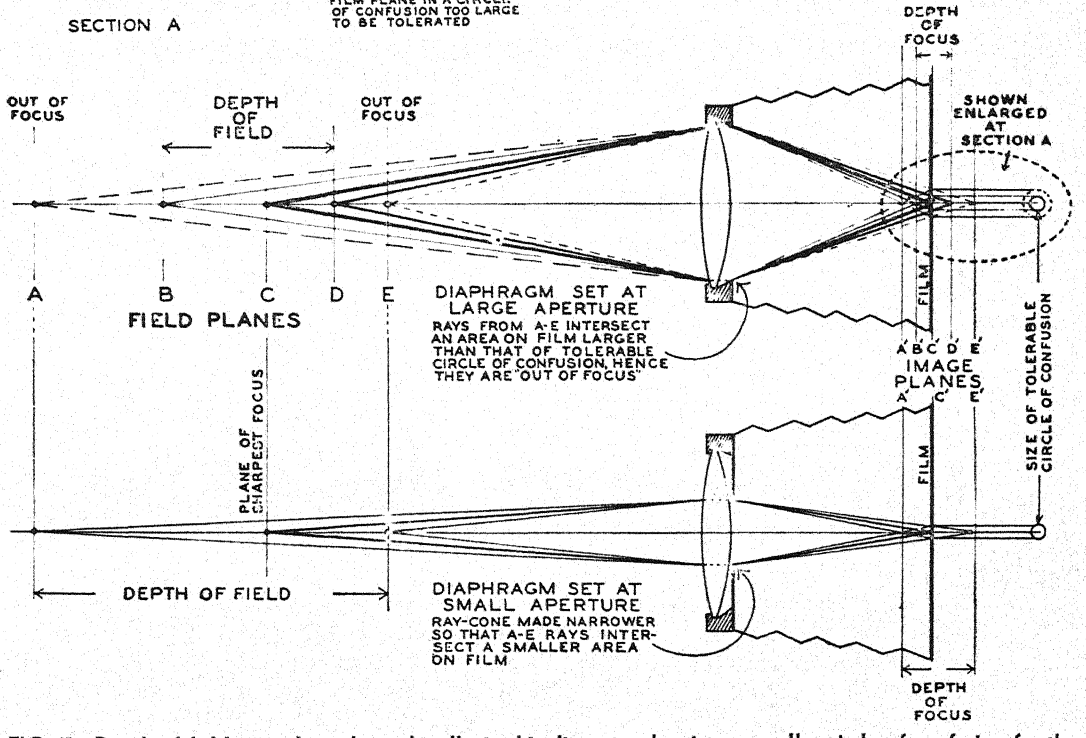


FIG. 7. Depth of field is explained graphically in this diagram, showing a smaller circle of confusion for the smaller aperture (center). The detail given above shows the formation of an out-of-focus point image, as seen in the dotted area

This is evident when the focusing scales of a 3-inch and a 6-inch lens are compared with each other with respect to the spacing of the intervals (see Figure 3). The focusing distance intervals for the 6-inch lens are four times as great as the intervals for the 3-inch lens. The images for the different subject distances are as far apart as the corresponding scale intervals because the scale merely indicates how far the lens must be moved to focus objects at a given distance on the film.

Suppose that two images can be 1/16 inch apart for a certain aperture of the 6-inch lens and still appear sharp. With the 3-inch lens at the same relative aperture, this permissible separation of two images is 1/32 inch, because of the smaller disk of confusion permissible in the smaller-sized picture. But 1/16 inch on the scale for the 6-inch lens covers less subject distance than 1/32 inch does on the scale for the 3-inch lens. Therefore, a greater range of subject space is in focus for the 3-inch lens. This is also true when the two pictures are enlarged to equal size.

Depth of Field and Subject Distance. Depth of field is affected most of all by the subject distance or distance focused upon. *The greater the subject distance, the greater the depth of field.* This again is evident from an examination of the focusing scale. For example, on the focusing scale for a 6-inch lens, the distance between the 50- and 100-foot marks is practically the same as the distance between the 10- and 12-foot marks. Thus at 50 feet the depth is about 50 feet while, at 10 feet the depth is only about 2 feet.

Hyperfocal Distance. Closely related to depth of field and a necessary value for depth of field computations is the "hyperfocal distance" (see article on *Depth of Field and Hyperfocal Distance*). The hyperfocal distance may be defined as that distance for which the camera lens is focused so that all subjects from infinity to one-half the distance focused upon are within the depth of field of the lens and hence are imaged with satisfactory sharpness. Thus, if a certain lens is focused for its hyperfocal distance of 60 feet, all subjects from 30 feet to infinity will be sharply imaged. However, since this is a special use of depth of field, subjects in the middle distances (60 feet) will be imaged most sharply while subjects near the lens and far from the lens will be less sharp but still satisfactory.

The hyperfocal distance is made use of in the design of fixed focus cameras. With cameras of this type, since it is impossible to secure wholly sharp focus for subjects at all distances at one setting, the lenses are sharply focused on the point nearest to the camera which enables distant subjects to appear acceptably sharp in the picture. By this means, subjects in the middle distance are perfectly sharp, and near subjects are also sharp, provided they are not too close to the camera.

Conclusions on Depth of Field. Data of practical value from depth of field calculations may be stated thus:

1. The smaller the stop, the greater the depth.
2. The depth decreases rapidly as the subject focused upon approaches the camera. It is, therefore, important to determine the distance for near subjects more carefully than for distant subjects. (It is not possible for the average person to guess a 6-foot distance accurately enough if working at f/4.5.)
3. For the same magnification on the film (not the same subject distance) and the same aperture (f-number), lenses of all focal lengths have the same depth of field.
4. For the same subject distance and relative aperture, the depth decreases with increasing focal length. A miniature camera negative, enlarged to the size of a larger camera contact print, shows greater depth than the latter, provided both are taken at the same distance and relative aperture.
5. For prints enlarged to equal size, all lenses of the same actual diameter (not relative aperture) have the same depth. A 16mm Cine-Kodak at f/1.9 has the same depth as a Recomar 33 at f/11, because at these settings, the effective diameter of both lenses is 12.5 mm.

PERSPECTIVE

As stated in the introduction to this section, one of the purposes of a photograph is

to present a faithful reproduction of a scene. A faithful reproduction, one which "looks" like the original scene, must have the proper perspective or "drawing."

Perspective Distortion. Perspective problems arise most frequently in close-ups. For example, many portraits and close-ups of other subjects made by amateurs are distorted. A certain amount of distortion is not objectionable to most, but in many cases the distortion could be eliminated almost completely by choosing a proper viewpoint or by proper posing of the subject. A common fault in posing seated subjects is to have the subject's knees running toward the camera. In the negative and print, the knees are too large in relation to the rest of the figure. In pictures of automobiles, the car is often photographed at too acute an angle. The result, due to perspective distortion, is a large radiator grille and front fender with the rest of the car lost in the background. Still another very common result of perspective distortion is the converging verticals seen in pictures of tall buildings where the photographer has tried to take in the whole building by tilting the camera upwards.

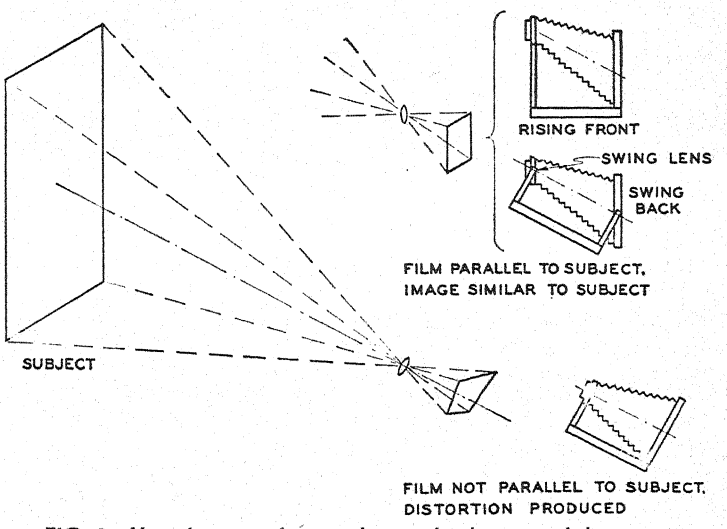


FIG. 8. Use of a rising front and swing back to avoid distortion

Rules for Correct Perspective. Most perspective problems can be overcome by following a few simple rules, and three of them are listed below:

(1) Keep the film plane parallel to the plane of the subject.

(2) Do not photograph at close range with short focal length lenses. With ordinary hand cameras, the focal length of the lens is seldom great enough to permit photographing people or medium-sized objects closer than 8 or 10 feet without unpleasant distortion resulting.

(3) For correct perspective, view the contact print from a distance equal to the focal length of the lens used to make the negative. This is not always convenient, and there is a very simple means of obtaining the same result. The viewing distance for correct perspective in an enlargement is equal to the focal length of the camera lens multiplied by the degree of enlargement. Thus, if a negative made with a 4-inch lens is enlarged by a factor of 4X, the correct viewing distance is 4 x 4 or 16 inches.

Camera Adjustments. Professional and commercial photographers and illustrators make use of cameras having devices designed to overcome perspective distortions and depth of field problems. These devices include rising, falling, and tilting lens fronts and tilting and swinging camera backs. The use of these devices requires much skill, experience, and patience on the part of the photographer and a detailed description would be out of place here (see *View Cameras* article). Figure 8 shows some of the methods of use. Figure 9 shows its effect in a photograph, while Figure 10 gives its relation to depth of field.

SUPPLEMENTARY LENSES

Supplementary lenses are weak positive or negative lenses which are intended to be used over the camera lens. Positive supplementary lenses, as exemplified by Kodak Portrait Attachments and Kodak Portra Lenses, produce large images of small objects close to the camera. Negative supplementary lenses, such as Kodak Telek Lenses, produce large images of distant subjects, i.e. telephoto effects.

Positive Supplementary Lenses. The Kodak Portrait Attachment is a positive meniscus lens with a power of ¾ diopters—that is, a focal length of 52½ inches. (The dioptric power of a lens equals

1/focal length in meters.)

The action of a portrait attachment or any positive supplementary lens can be explained as follows: When an object on one side of a positive lens is at a distance greater than the focal length of the lens from the lens, a real image is formed on the opposite side of the lens. But, if the object is at a distance equal to or less than the focal length of the lens, then a virtual image is formed on the same side of the lens as the object. This is shown in Figures 11 and 12.

Subject Distance and Focusing Scale Setting. Thus, when a positive lens is used as a supplementary lens for a camera lens, the camera lens is focused upon the virtual image. The distance S, which is the camera focusing scale setting, can be computed easily from the following relation, where U equals distance from subject to supplementary lens and F equals focal length of the supplementary lens.

$$S = \frac{UF}{U-F}$$

While this computation is very simple and requires very little effort on the part of the photographer, a table of subject distances and camera focusing scale settings is included with all Kodak Portrait Attachments and Kodak Portra Lenses. These tables are applicable to all cameras since the focusing scale setting depends only on the



FIG. 9. The effects of camera adjustments are shown in this photograph of the Coca Cola Laboratory. To achieve sharpness of detail all over the field—an important feature in this particular photograph—the objects in the near and far planes were brought to a maximum focus at full aperture with the use of front and rear camera swings. Notice how distortion has also been avoided. DATA: Deardorff 4 x 7 Commercial Camera, Super Dagor 6-inch lens, fast press pan film, 2 seconds, f/45. Three No. 4 photoflood lights were combined with daylight to make the illumination scheme

Photo by Alexander Alland for D'Arcy Advertising Agency

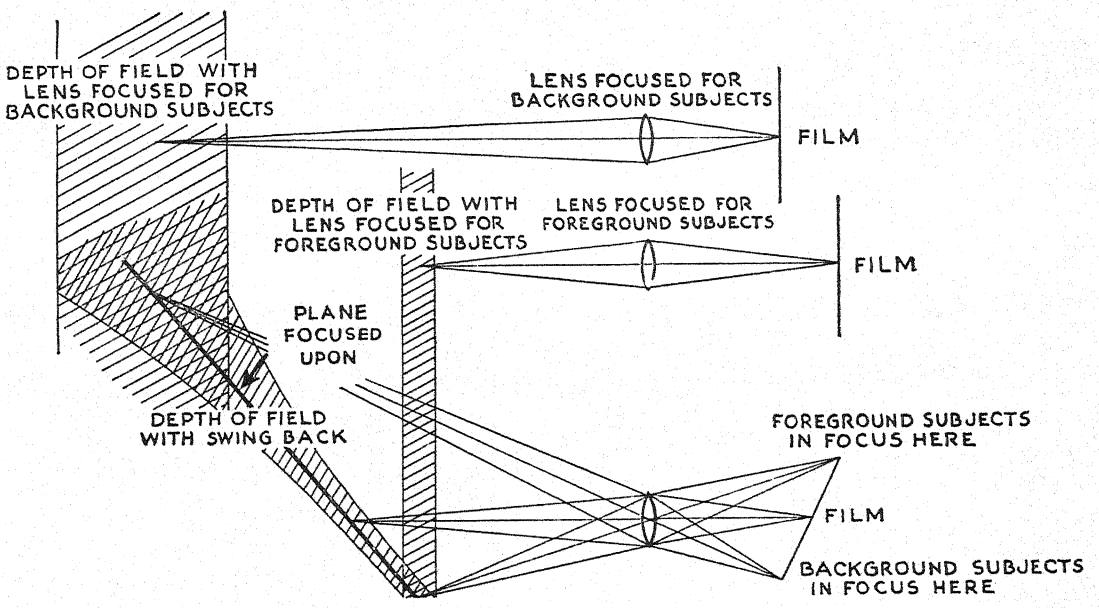


FIG. 10. Depth of field with the swing back. The diagram shows graphically that greater depth of field is obtained with the swing back (below) than when the lens is focused for background (above) or foreground (center)

focal length of the supplementary lens and the subject distance, and are independent of the camera lens.

The following Table I has been computed for supplementary lenses having focal length of: 52½ inches (Kodak Portrait Attachment ¾ + D); 39½ inches (Kodak Portra 1+ Lens); 19¾ inches (Kodak Portra 2+ Lens); 13⅛ inches (Kodak Portra 3+ Lens).

The field covered when supplementary lenses are used is fixed by the camera lens-to-film distance and the film dimensions (Figs. 13 and 14). To find the linear dimensions of the field covered when supplementary lenses are used, multiply the supplementary lens-to-subject distance by the film dimension and divide by the camera lens-to-film distance. The camera lens-to-film distance is equal to the focal length of the camera lens plus the extension from the infinity position of the camera lens. This calculation must be carried out for both the long and short film dimensions.

Magnification and Field Size. The magnification on the film, when using positive

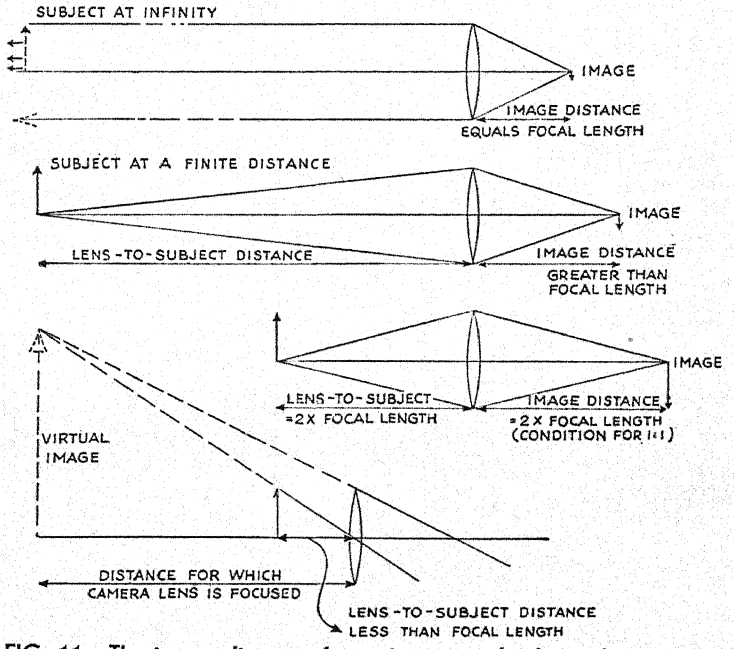


FIG. 11. The image distances for various normal subject distances are shown in the top three diagrams. Below is a diagram of an extreme close-up, where the lens-to-subject distance is less than the focal length. In this case, the virtual image lies beyond the subject and, with a portrait attachment, it is the virtual image upon which the lens is focused

TABLE I

Focusing Scale Setting		*Subject-to-Supplementary Lens Distance*			
Meters	*Ft. and In.*	*Kodak Portrait Attachment*	*Kodak Portra 1+ Lens*	*Kodak Portra 2+ Lens*	*Kodak Portra 3+ Lens*
	1′ 6″	1′ 1½″	12⅜″	9½″	7⅝″
	2	1 4½	1′ 3	10⅞	8½
	2 6	1 7	1 5	11⅞	9⅛
	3	1 9½	1 7	12¾	9⅝
1.	3 3	1 10	1 7½	1′ 1⅛	9¾
	3 6	1 11¼	1 8¼	1 1⅜	10
1.2	3 11	2	1 9½	1 1⅞	10¼
	4	2 1	1 9¾	1 2	10⅜
1.5	4 11	2 3	1 11¾	1 2¾	10¾
	5	2 4	1 11⅞	1 2⅞	10¾
	6	2 6	2 1½	1 3½	11⅛
2.	6 7	2 6½	2 2½	1 3¾	11¼
	7	2 7	2 3	1 4	11⅜
	8	2 10	2 4	1 4⅜	11½
2.5	8 2	2 10	2 4⅛	1 4½	11½
3.	9 10	2 11	2 5½	1 4⅞	11¾
	10	3	2 5¾	1 5	11⅞
	12	3 2	2 7	1 5⅜	12
4.	13 1	3 2½	2 7½	1 5½	12⅛
	15	3 4	2 8½	1 5¾	12¼
6.	19 8	3 6	2 10	1 6¼	12⅜
	20	3 7	2 10	1 6¼	12½
	25	3 8	2 11	1 6½	12⅝
10.	32 10	3 9	3	1 6¾	12¾
	50	4	3 1	1 7	12⅞
	100	4 2	3 2	1 7½	1′ 1
Inf.	*Inf.*	4 4½	3 3½	1 7¾	1 1⅛



FIG. 12. The photo at the left was made without a supplementary lens and the features of the girl are slightly out of focus. With the same subject distance, a portrait attachment (3/4+D) was used to produce the photo at the right

supplementary lenses is easily computed by dividing the camera lens-to-film distance by the supplementary lens-to-subject distance. If the magnification has been found, the field size can be computed by dividing the film dimensions by the magnification. Likewise, if the field size is known, the magnification on the film can be computed by dividing the film dimensions by the field size. (Fig. 15.)

No increase or decrease in exposure is necessary when positive supplementary lenses are used.

Wide-Angle Effects with Groundglass Focusing Cameras. Positive supplementary lenses have a second application with groundglass focusing cameras. With a positive lens over the regular camera lens, the resulting combination has a combined focal length less than that of the camera lens alone. When the combination is focused, the lens-to-film distance is shorter than when the camera lens alone is used, but the negative size remains constant. This results in a wide-angle effect because the angle subtended by the film is larger than when no supplementary lens is used. (Fig. 16.)

NEGATIVE SUPPLEMENTARY LENSES

For telephoto effects, i.e. pictures of distant subjects which appear to have been

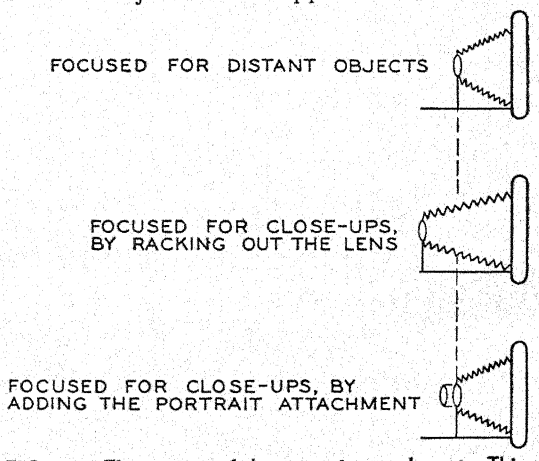


FIG. 13. The action of the portrait attachment. This shows how the supplementary lens at normal lens extension can be the equivalent of a bellows camera racked out for a close-up

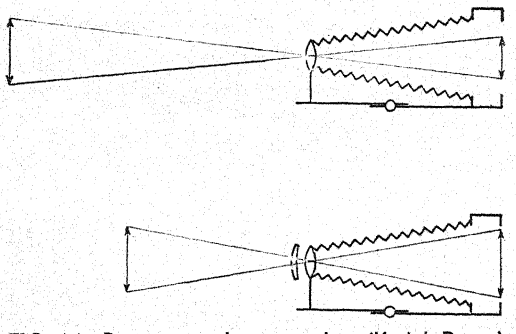


FIG. 14. Positive supplementary lens (Kodak Portra) used at full bellows extension for larger pictures of small subjects

taken at close range, negative supplementary lenses are used (Fig. 17). Such lenses are exemplified by the Kodak Telek 2-, 3-, and 4- lenses (Fig. 18). Since a negative lens, used in combination with a camera lens, effectively lengthens the focal length of the combination, negative supplementary lenses cannot be used with folding pocket cameras with limited bellows draw. Their only application is for use with groundglass focusing cameras. Focusing must be done on the groundglass and the bellows is always considerably extended beyond the closest normal subject distance setting.

Table II (below) has been computed for Kodak Portra and Telek Lenses when used with camera lenses having focal lengths of 105mm and 135mm, which are more or less standard for 2¼ x 3¼ and 3¼ x 4¼ cameras respectively. It will be noted that *the reduction in effective relative aperture due to the increased lens-to-film distance must be compensated for by increasing the exposure.*

NOTES ON THE USE OF SUPPLEMENTARY LENSES

The following points should be borne in mind when using supplementary lenses.

1. For best results, the supplementary lenses should be meniscus in form. Bi-convex or bi-concave lenses reintroduce considerably more aberration in the image and in particular spherical aberration and distortion.

2. *Any supplementary lens is bound to have an adverse effect upon the definition of the camera lens.* In order to produce the most satisfactory results, the camera lens should be stopped down to *at least* f/8 and better results may be obtained if a still smaller relative aperture is used. (The optimum f-number depends upon the focal length of the camera lens and the power of the supplementary lens.) This is not due to any fault either in the supplementary lens or the camera lens but rather to the fact that sup-

TABLE II

	Kodak Portra Lenses			*Kodak Telek Lenses*	
2¼ x 3¼ CAMERA WITH 105mm LENS	*1+*	*2+*	*3+*	*2—*	*3—*
Combined focal length	95mm	87mm	80mm	133mm	154mm
Image enlargement or reduction	.90 X	.83 X	.76 X	1.27 X	1.47 X
**Exposure multiplying factor*	.80 X	.68 X	.57 X	1.60 X	2.14 X
3¼ x 4¼ CAMERA WITH 135mm LENS					
Combined focal length	119mm	105mm	96mm	185mm	227mm
Image enlargement or reduction	.88 X	.78 X	.71 X	1.37 X	1.68 X
**Exposure multiplying factor*	.79 X	.60 X	.50 X	1.90 X	2.85 X

*An exposure multiplying factor of .5 X indicates one lens opening smaller; 1.0 X same lens stop; 2.0 X one lens opening larger. The exposure indicated for the camera lens alone should be multiplied by this factor.

plementary lenses may under certain conditions offset some of the lens corrections.

3. The depth of field is extremely small. In the case of positive supplementary lenses, the small depth of field is due to the short subject distances. When photographing subjects at such short distances, the subject distances *must* be carefully measured.

4. In the case of negative supplementary lenses, the reduced depth of field is due to the effective increase in the focal length of the combination. However, since in this case distant objects are usually being photographed, the loss in depth is not so objectionable.

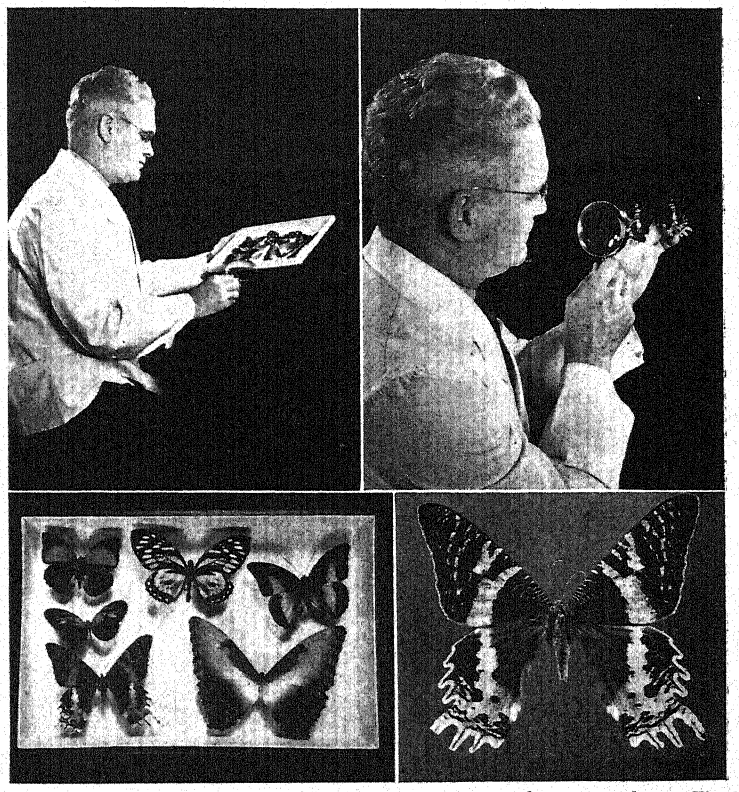


FIG. 15. Close-up possibilities with a positive supplementary lens. The photo at top left was taken with no supplementary lens, while the top right shows use of a Portra 1, with Portra 2 (below left) and Portra 3 (below right)

RESOLVING POWER

In recent years, and especially since miniature cameras have become so popular, much emphasis has been placed on the "resolving power" of lenses. In practice, the resolving power of most well-corrected lenses, on the axis or in the central part of the field covered, is much higher than can be utilized by the various sensitized materials available. This fact is more or less evident if the problem of resolving power is clearly understood by the photographer.

On the basis of physical optics, the resolving power of a lens is dependent solely upon the wave length of the light used to photograph two separated points and the actual diameter of the lens aperture. Even when a perfect lens (which can be obtained only in theory) images a point source such as a distant star, the image is not a point but rather a small disc surrounded by a series of faint concentric circles of light. These concentric circles are caused by the diffraction or bending of the light rays around the edge of the aperture or the lens itself. This disc and its surrounding rings are called the "Airy Disc." Experience has shown that the diameter of this central disc in modern well-corrected lenses is equal to:

$$2\lambda f/d$$

Where λ = the wave length of light (.0005mm)

f = lens-to-image distance

d = effective diameter of the lens

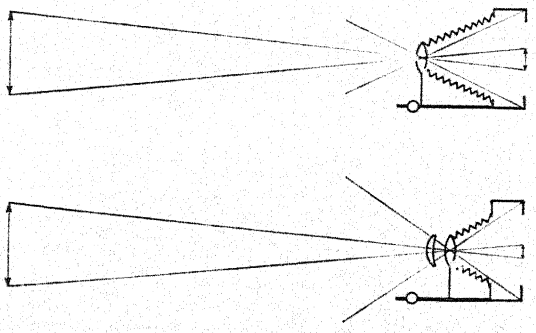


FIG. 16. Kodak Portra lens used for wide-angle work

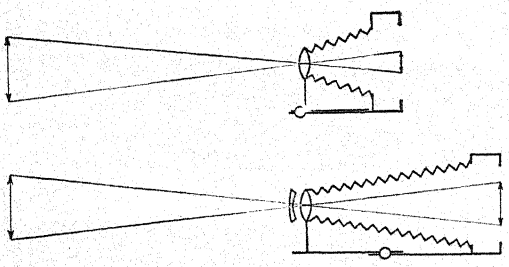


FIG. 17. A negative supplementary lens, the Kodak Telek, has been added to a normal lens to produce a larger image (below) than a normal lens at the subject distance (above)

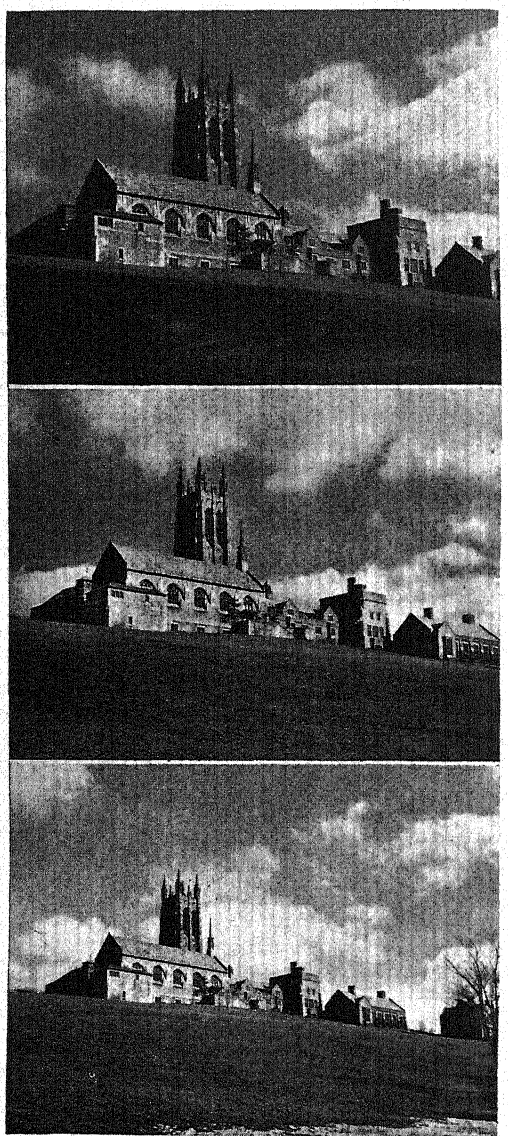


FIG. 18. Three photographs taken from the same spot. The one below was taken with a normal lens; center with a Telek 2 lens; above with a Telek 3 lens

But f/d equals the effective relative aperture, A, of the lens. Therefore the practical diameter of the airy disc is:

$$2\lambda A$$

On this basis two points will be just resolved if the separation of the images of the points is equal to one-half this value (or λA). Thus at f/4.5 a lens could resolve adjacent images separated by only .00225mm, which is equal to over 400 lines per millimeter. This is much higher than the resolving power of any emulsion available at the present time and therefore the practical or photographic resolving power of a lens cannot be measured. Visual resolving power measurements are sometimes made with the aid of microscopes. However, images of fine gratings or other resolving power test objects are always more or less obscured by diffraction and other physical phenomena which make absolute measurements impossible. It is well known that the visual resolving power is dependent upon the wave length of light, the effective diameter of the lens, the contrast of the object, magnification used in examining the image, the angle from the axis, etc., and unless all of these factors are clearly stated, such measurements are of little value.

DEFINITION

Much more important than high resolving power in a photographic objective is its definition. We have seen that as the lens is "opened up" (i.e. the larger the aperture) the resolving power increases (the smaller the disc's diameter). However, when the image of an artificial star, as formed by the lens, is examined on a lens bench, the character of such an image changes slightly for different relative apertures. Decreasing the aperture from wide open generally improves definition slightly and removes the slight haze caused by residual spherical aberration. In a good lens this haze usually disappears almost completely for an aperture decrease of one full stop. As a result, there is a slight increase in image contrast. Definition generally improves in the center of the image area for the first full stop decrease, but remains practically unchanged by further stopping down until f/16 is reached. How-

ever, definition away from the center of the field is slightly improved by decreasing the aperture to about two or three full stops below the maximum aperture. Usually, except in the case of lenses poorly designed or manufactured, there is little change on further aperture decrease, except for continued increase in depth of field. However, at very small stops, a slight decrease in definition may be noted because of diffraction at the diaphragm.

The question often arises, especially in miniature camera work, how small an aperture can be used without loss of definition. For all apertures normally available, f/22 or larger, the limiting definition is imposed by the type of film used and not by the lens. An aperture of f/22 or f/16 may limit definition in the case of a slow, extremely fine grained copying film like Kodak Micro-File. Hence in such cases f/8 or f/11 may be preferable.

The use of enlarging lenses at very small apertures may limit print definition in extreme sizes, but not in ordinary work.

It should be emphasized that the relatively small changes in lens performance with aperture changes are of little consequence. These effects on definition are much smaller than those due to slight errors in camera technic such as focusing, subject motion, and camera motion. (Recently, there has been some evidence to prove that with some small, very light-weight cameras, "shutter shock" caused by the rapid opening and closing of the shutter may affect the negative quality. The effect is most noticeable at high shutter speeds and with very light cameras.)

CARE OF LENSES

For best performance of a lens:

Do not allow a lens to fall or to get a sudden jar.

Protect the lens as much as possible from dust and finger marks.

Use a carrying case and keep folding cameras closed when they are not in use.

Do not subject a lens to sudden and extreme temperature changes, nor keep it near a steam pipe.

Do not expose it for long periods to direct rays of the sun.

Avoid keeping a lens in damp places.

Never use acids, alcohol, or other solvents for cleaning.

Occasional cleaning is not only advisable, but also very necessary when the lenses show dust, finger marks, or moisture on the surfaces. Lens cleaner and lens tissue are supplied for this purpose and are especially recommended.

If the inner surfaces require cleaning, return the lens to the manufacturer. *Never attempt to take a lens apart.*

Should a lens or mounting require more attention than the above, return it to the manufacturer.

LENSES AND THEIR CHARACTERISTICS

R. Kingslake

Head of Lens Design Department, Eastman Kodak Co.

Some of the more important properties of a lens have already been covered in the *Lenses* article. Here a few of them are elaborated upon and the fascinating story of the history and manufacture of a photographic lens is also given. A lens expert tells about the more technical aspects of lens optics—including lens speed, surface reflection, and resolving power.

See Also Circle of Confusion, History of Photography, Lens Optics and Lens Types, Lenses, Lenses With Surface Coating

SINCE 1830 we have advanced from the simplest possible lens of very low aperture to the modern complex anastigmat. Throughout this period, the greatest advance in photographic lenses has been in the direction of increased speed, the demand for which has led to continual activity among lens designers to discover new and better types of construction by means of which faster lenses can be obtained. The net result of this enormous amount of work is that today we have f/1.5 and f/2.0 lenses which are better than the best f/8 lenses of 60 years ago, and yet cover the same angular field.

THE DESIGN OF PHOTOGRAPHIC LENSES

Prior to 1812, when the camera obscura was a familiar optical means of entertainment, lenses were ordinarily either biconvex or plano-convex in shape, and no attention was paid to the problem of determining the best form of lens for a particular problem.

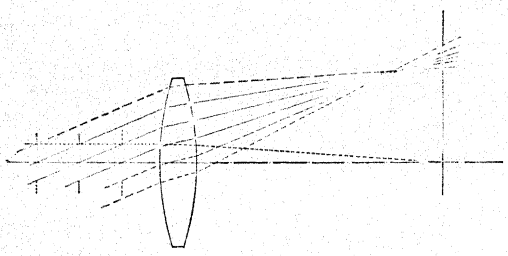


FIG. 1. Ray diagram for a biconvex lens

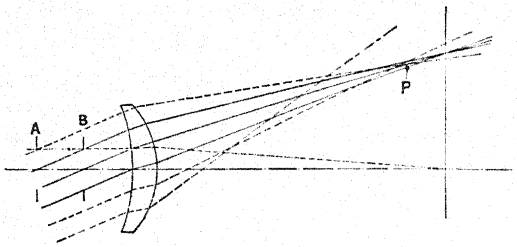


FIG. 3. Ray diagram for a meniscus lens

Actually, the familiar equiconvex lens was a particularly unfortunate choice when a moderately wide field was to be projected onto a flat receiving surface, as is evident in Figure 1.

In 1812, Wollaston discovered that the image seen in a camera obscura could be made to cover a much wider field with satisfactory definition by the use of a meniscus-shaped lens with a small stop near its concave side. An indication of the improvement in definition resulting from this important invention is seen in Figure 2. This "landscape lens," as it is called, marked the beginnings of photographic lens design, and almost all subsequent lenses embody some of the principles underlying its action.

The ray diagrams in Figures 1 and 3 will help us to understand the improvement achieved by Wollaston's invention. In Figure 1 is shown the path of an oblique beam of light entering an equiconvex lens, indicating the bad lack of union of the rays on the image plane in this case. An improvement may be made by the introduction of a small stop, but even if this is done, the oblique image falls too close to the lens, causing a curved field. In Figure 3 the corresponding ray distribution is shown for a meniscus-shaped lens, and it is seen that the field is now much flatter. Indeed, by a suitable choice of lens shape and stop position, it is possible to secure a flat image field free from "coma," which is the name given to the one-sided flare which results if the stop is placed at an unsuitable position.

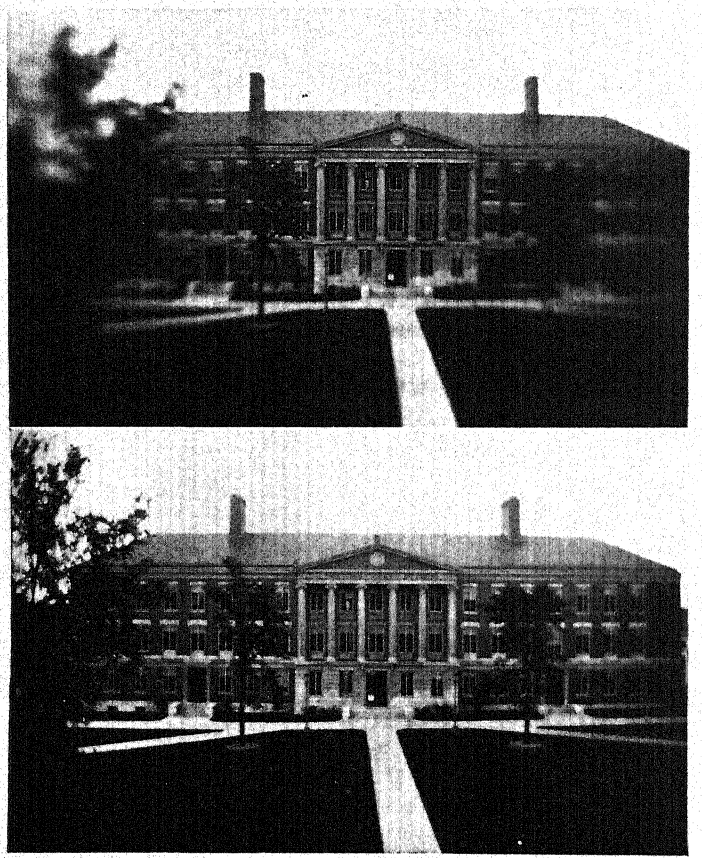
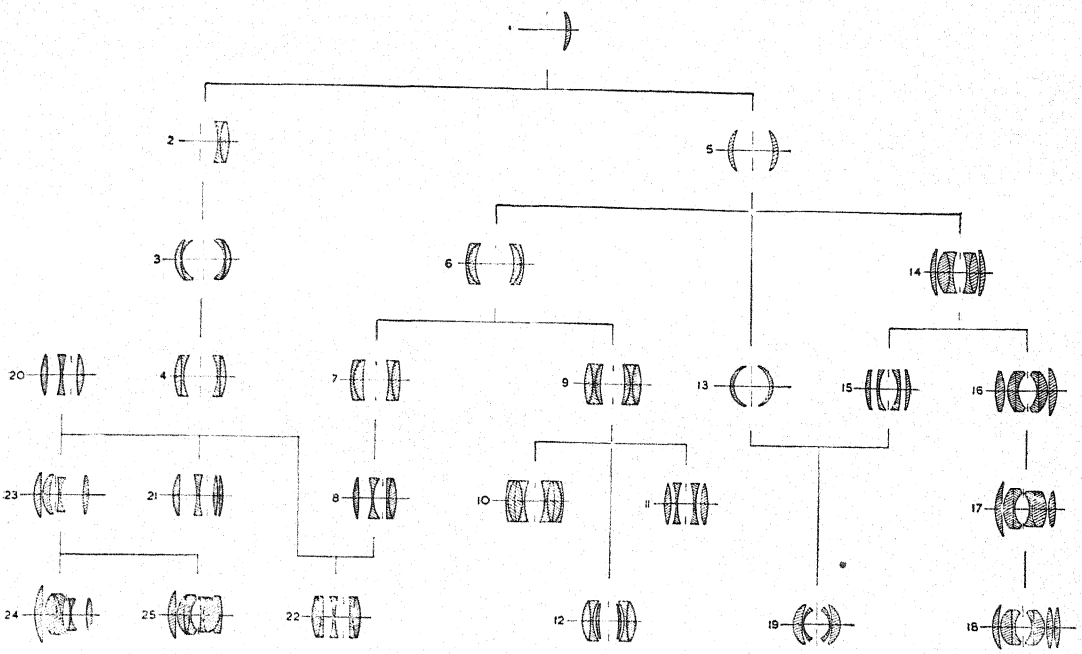


FIG. 2. The photograph above was taken with a biconvex lens at f/8. Below is a picture taken by a meniscus landscape lens at f/8

In Figure 3, it can be seen that coma will result if the stop is placed at A, for then the upper and lower rays will cross each other at P, which is definitely to one side of the ray through the middle of the aperture. On the other hand, with the stop at B, it will be noticed that the upper and lower



No.	*Name*	*Designer*	*Date*	*F-No.*	*Angular Semi-Field*
1	Landscape	Wollaston	1812	11	25°
2	Achr. Landscape	Chevalier	1821	11	25°
3	Globe	Harrison and Schnitzer	1862	17	45°
4	Concentric	Schröder	1888	16	45°
5	Periscopic	Steinheil	1865	16	25°
6	Rapid Rectilinear	Dallmeyer	1866	8	25°
7	Protar	Rudolph	1891	12	40°
8	Tessar	Rudolph and Wandersleb	1902	4.5	25°
9	Dagor	V. Höegh	1892	8	35°
10	Double Protar	Rudolph	1895	6.3	35°
11	Celor	V. Höegh	1898	4.5	24°
12	Plasmat	Rudolph	1920	4.5	32°
13	Hypergon	V. Höegh	1900	30	70°
14	Planar	Rudolph	1895	4.0	25°
15	Omnar	Martin	1902	4.5	30°
16	Opic	Lee	1920	2	25°
17	Biotar	Merté	1927	1.4	14°
18	Xenon	Tronnier	1933	1.3	14°
19	Topogon	Richter	1933	6.3	45°
20	Cooke	H. D. Taylor	1895	4.5	25°
21	Speedic	Lee	1926	2.5	22°
22	Heliar	Harting	1902	4.5	25°
23	.....	Bertele	1923	2	14°
24	Ernostar	Bertele	1924	1.8	22°
25	Sonnar	Bertele	1934	1.5	24°

FIG. 4. Some of the important landmarks in the development of the photographic objective. For identifications see list above

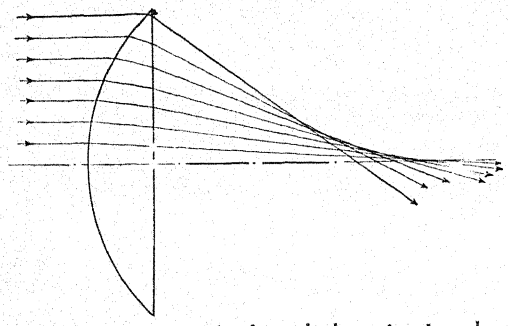


FIG. 5. The effect of spherical aberration in a lens

rays cross on the middle ray, and now the oblique image is evidently situated as far back from the lens as possible, resulting in the greatest possible flattening of the field.

The principal defects of the landscape lens are its low speed (f/11) and its inevitable distortion and lateral color. Distortion is a variation in magnification over different parts of the field, and lateral color is a variation in the image size for different colors.

The latter defect of the simple landscape lens was removed by C. Chevalier in 1821, who suggested achromatizing the landscape lens by the use of a crown and flint glass component, see Figure 4(2). This was quite a remarkable achievement when it is remembered that optical glass with precisely known refractive index and dispersion was only just becoming available at that time through the efforts of Fraunhofer and Guinand. Photography was not introduced until several years later, by Daguerre in 1839 and Fox Talbot in 1841, and the improvements just described were introduced merely to improve the camera obscura.

Various attempts were made around 1860 to remove the distortion of a landscape lens. The only one of these experiments to survive was the symmetrical or almost symmetrical "periscopic" lens first introduced by A. Steinheil in 1865, Figure 4(5). The symmetry of this type of construction provides an almost complete elimination of distortion and lateral color, and a drastic reduction of the coma. The periscopic principle has found successful application in recent extreme wide-angle lenses such as the Hypergon, and the f/6.3 Topogon lens used in aerial surveying, Figure 4, (13) and (19).

Unfortunately, none of the types so far discussed was capable of being opened up above about f/11, and many good lenses were made which failed to reach even that aperture. The cause of this failure was the presence of *spherical aberration*, a defect in which rays through the outer zones of the lens intersect at a point on the axis closer to or further from the lens than the focus for the central rays. Figure 5.

Petzval Lens. The success of the daguerrotype process prompted early workers to attempt portraiture, but the slow speed of available lenses proved an almost insurmountable barrier. Professor Petzval of Vienna, therefore, undertook in 1841 the arduous problem of designing a lens which could be used at a high relative aperture for portraiture. After working on the problem for about a year, he produced his famous portrait lens which covered a 10° semi-field at an aperture of about f/3.3. This achievement was the more remarkable when it is realized that so fast a lens had never before been attempted, and that systematic lens design as we know it today was then nonexistent.

Petzval's lens consisted of two thin achromatic doublets (Fig. 6), one cemented and one airspaced. In later years the aperture was raised and the rear air space was eliminated by various workers, and today the same fundamental type is used successfully at f/1.6 in projection and in other lenses which must give satisfactory definition over a field of not more than about 7° half angle. The improvement has come partly from improved design, but also because of the availability of barium crown glass, developed by Abbe and Schott in 1886. For example, the Kodak

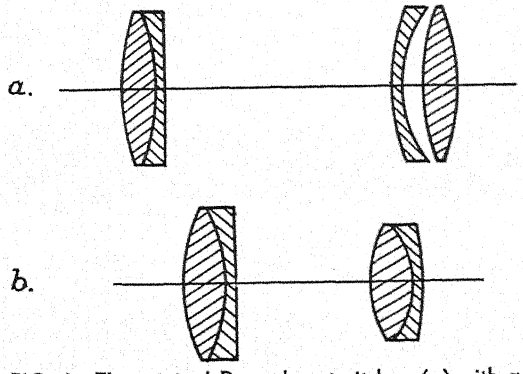


FIG. 6. The original Petzval portrait lens (a) with a speed of f/3.4 and a modern projection lens (b) with an f/1.6 speed

f/1.9 Cine lens (covering 14°) is an air-spaced Petzval lens using barium crown and dense flint glass.

We thus see the working of a very general rule in optics—that wide aperture and wide field are ordinarily incompatible. The landscape lens covered 25° half angle at f/11, while the early Petzval lens covered only 10° at f/3.3. The problem of making lenses of high aperture covering a field as wide as that of the old landscape lenses has challenged the lens designer for the last 100 years.

Rapid Rectilinear Lens. As has been indicated, the problem is to devise an arrangement of lenses which is spherically corrected (so that a large aperture may be used) and which covers as wide a field as possible.

The Rapid Rectilinear lens, Figure 4 (6), discovered simultaneously by J. H. Dallmeyer and A. Steinheil in 1866, was the first attempt to bridge this gap. It was essentially a spherically corrected periscopic type of lens, working satisfactorily at about f/8. As in the periscopic lens, its field was limited by the astigmatism which increases as the field is widened until it becomes unbearably great at an angle of perhaps 25° from the axis.

Anastigmats. From 1870 on, lens designers devoted almost their whole attention to the problem of eliminating the astigmatism and so widening the angular field of lenses. To this end, Abbe and Schott investigated the possibility of introducing new types of optical glass, and it was as a direct result of their discoveries that the Protar of Rudolph, Figure 4 (7), and the Double Anastigmat (Dagor) of Von Hoegh, Figure 4 (9), were introduced in the 1890's. These lenses at f/8 cover a flat field out to 30° or more which is practically free from objectionable astigmatism—hence the name "anastigmat."

From the Protar lens, by making some changes and introducing an air gap in the front half, Rudolph and Wandersleb developed the Tessar type in 1902, Figure 4 (8). Von Höegh at the same time separated the elements of his Dagor lens to make the Celor, Figure 4 (11). Both of these types have been exceedingly popular, but in recent years the Tessar type has become established as the almost universal form of a good f/4.5 anastigmat for general purposes. The same type can be carried as far as f/3.5 or f/2.7, but other more elaborate types are generally preferable for these high apertures.

An independent line of thought led H. D. Taylor to discover the triplet or Cooke lens in 1895, Figure 4 (20). This form contains the smallest number of elements that can possibly be used to make a satisfactory photographic lens, and although it is not quite such a good type as the Tessar, the triplet has become a very popular form of construction for somewhat less expensive lenses, even up to apertures of f/3.5 over a 25° semi-field. Other forms of triplet can be designed to cover almost 30° at a speed of f/6.3.

Modern. Still another independent line of development was the 4-piece meniscus type of construction. This type was adopted by Rudolph in 1895 when he designed the f/4 Planar lens for process work, Figure 4 (14). It was later simplified by Martin and others in 1902 in the Busch Omnar and Meyer Aristostigmat, Figure 4 (15), and there matters stayed until the type was revived by Lee in 1920 in the Opic f/2 lens covering 25°, Figure 4 (16). This lens may be regarded as initiating the whole modern trend toward high speed lenses covering normal angular fields.

From Lee's lens, designers developed many useful modifications culminating in such modern lenses as the Leitz Summitar, the Schneider Xenon, and the Kodak Ektar, f/2.0. For cine purposes, this type has been applied in the Taylor-Hobson Speed Panchro f/2.0 and in the Zeiss Biotar f/1.4, Figure 4 (17). Cine lenses cover only about 14° half angle, which makes them much easier to design, and permits higher apertures than for ordinary camera lenses.

In recent years, the triplet type of construction has been attacked anew, by splitting either the rear crown, or preferably the front crown, into two air-spaced lenses. If the rear lens is divided, apertures of f/2.5 are obtainable, as for instance in the Astro Tachar and the Taylor-Hobson Speedic lenses, Figure 4 (21). By dividing the front element and making the second portion of meniscus form, Bertele has been led to the Ernostar lens, Figure 4 (24), and later to the Sonnar line of lenses made by Zeiss. The present-day Sonnar f/1.5, Figure 4 (25), is one of the best lenses of that aperture to cover a field greater than 20° half angle.

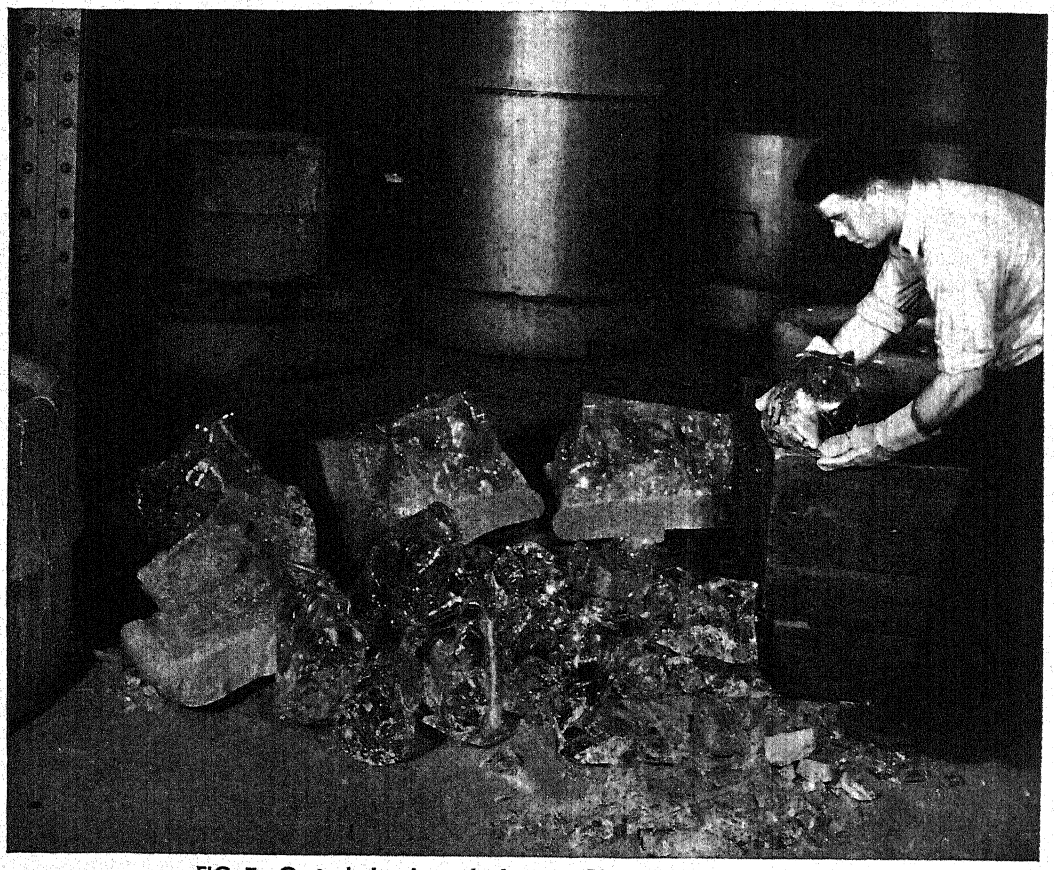


FIG. 7. Optical glass being broken up. Photo from Bausch & Lomb

In the above brief outline, only a very few of the better-known lenses have been mentioned, and these only as landmarks of progress. Many other excellent lenses are available, some of which are of outstanding interest and performance.

THE MANUFACTURE OF LENSES

Lenses are made from optical glass, which differs from ordinary glass in several important respects. First, its composition must be very carefully controlled in order to maintain the optical properties constant within exceedingly small permissible variations during successive meltings. Second, it must be very free from color, bubbles, dirt or stones, striations, and internal strain. The ingredients are weighed out into large clay crucibles and melted in a gas furnace, after which the melted mass is stirred for a long time to render it perfectly uniform throughout. It is then allowed to cool. The crucible and outer layers of poor-quality glass are knocked away (Fig. 7) and the remaining acceptable glass is broken into reasonable sized pieces ready for remelting and casting into flat slabs or pressing into "blanks" having the approximate sizes of the lenses to be made.

The manufacture of optical glass was a European monopoly prior to the war of 1914-1918. At that time the problem was attacked at two or three places in the United States, and by 1920 satisfactory optical glass was being manufactured here. Continued progress has been made since the war by the Bausch and Lomb Optical Company. With the European supply again stopped by World War II, some other American manufacturers started to make optical glass. The Eastman Kodak Company has recently announced an entirely new type of optical glass, made without the use of silica (sand), and incorporating the oxides of some rare-earth elements.

This glass has a much higher refractive index than silica glass of the same dispersive power, and will make possible great improvements in the image quality of lenses.

Grinding and Polishing. The rough lens "blanks" made by pressing the heated optical glass into an iron mould, are taken to the grinding and polishing shops. To save expense and to improve the average quality of surfaces, several lenses are usually "blocked" together with pitch on an iron "body" in such a way that their outer faces all lie in the same spherical surface ready for grinding. To secure this arrangement, each lens is first equipped with a small button of pitch on its rear surface. It is then temporarily attached by gumwater, face down, to a smooth spherical-shaped cast iron "tool" similar to the one which will ultimately be used for grinding. A suitable heated iron "body" is brought down on the pitch buttons, which melt and stick to the body, thus ensuring that the outside faces of all the lenses on the resulting block lie on the desired spherical surface (Fig. 8). A view of a number of large and small blocks of lenses in process of manufacture is shown in Figure 9.

Grinding is done by successively finer grades of emery and water, followed by polishing with wet rouge on a pitch-covered polishing tool accurately moulded to fit the spherical surface of the block of lenses. The spindle turns and the polisher is rocked back and forth for perhaps several hours before a completely satisfactory polish is obtained (Fig. 10). The lenses are tested periodically against a very accurate oppositely curved spherical glass "test plate," using Newton's

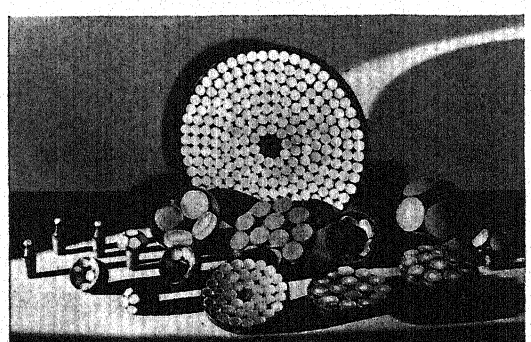


FIG. 9. Typical blocks of lenses ready for polishing. From Eastman Kodak

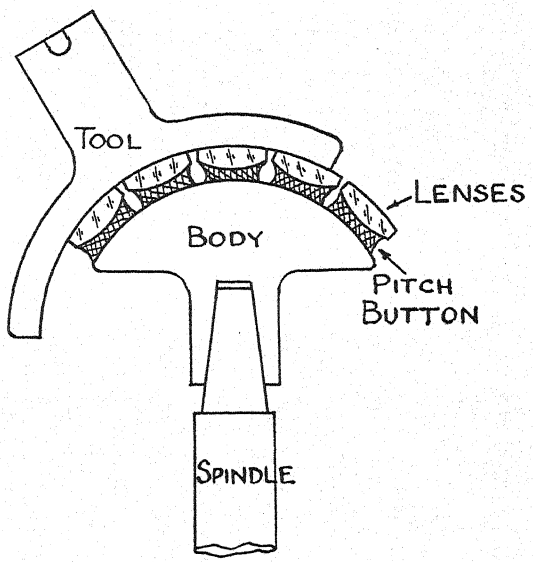


FIG. 8. Arrangement of lens blocking by means of pitch buttons

rings as a criterion of exactness of fit. This test not only checks the degree of sphericity of the surface, but also its exact radius of curvature (Fig. 11).

After one side is polished, the lenses are removed from the body and ground down singly by hand until the center thickness is correct, with due allowance of course for glass which will be removed in subsequent operations. The lenses are then affixed to new pitch buttons on their polished faces, and the processes of blocking, grinding, and polishing are repeated on the second side.

After the lenses have been cleaned and inspected, they are cemented to a rotating cup-like chuck and, while the cement is soft, they are moved laterally back and forth until the reflections of a bright light in both front and rear surfaces remain stationary while the lens is rotated about its axis. This process, known as "centering," ensures that the optical axis of the lens coincides with the axis of rotation of the chuck. The rim of the lens is then ground down to its desired diameter by emery and water, or by means of a rotating diamond-studded metal drum (Fig. 12).

Finishing. Lens elements to be cemented together are then warmed, a little Canada balsam is inserted between them, and the elements are laid together, worked around to expel air bubbles, and placed aside for the cement to set. Care must be taken to be

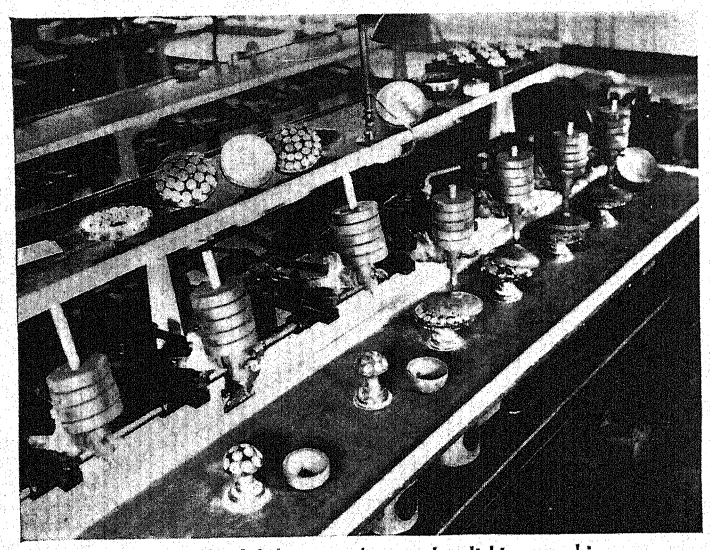


FIG. 10. Kodak lens grinding and polishing machines

sure that the optical axes of both elements come together in this operation, which becomes particularly difficult when three or more elements are to be cemented together into a single component (Fig. 13).

The best lens is of course useless without a mounting. The metal parts must be carefully drawn by a draftsman, who specifies the dimensions of lens seatings very exactly so as to hold the air spaces to the required width. The lens elements, when placed into their cells, are held in place, either by spinning a small metal lip over the bevel on the rear of the lens, or by a screwed ring tightened into place. Typical forms of lens mount are shown in Figure 14. The iris diaphragm and shutter also constitute important items of the lens mount problem.

The most difficult part of mounting a lens is to ensure that all the elements are centered relative to each other, in order that the optical axes of all elements shall coincide. Any tilt or sideways displacement of one element relative to the others results in an imperfect image. A tilted lens element is especially objectionable as it gives the lens a tilted field, which prevents the lens from producing a sharp image over the whole of a film which is accurately perpendicular to the intended lens axis.

Camera lenses are usually focused by varying the distance between the lens and the film. This requires a sliding front board or a long threaded focusing tube behind the shutter, and either procedure is attended with mechanical difficulties in camera design. Consequently, in recent years lenses have been extensively used in which the front lens element can be screwed back and forth over a short distance to focus the lens. This process is inevitably attended by slight changes in the definition and field curvature, but provided the best image has been secured by the manufacturer at about the middle of the focusing range, the result is usually quite satisfactory.

A completed lens is submitted to the final test of the lens bench. There the lens is made to form an image of a distant point source, which is examined through a powerful microscope (Fig. 15). The lens is then rotated about a vertical axis to any desired obliquity and changes in the form of the image are observed. Tolerances are available as to the shape and size of the image, by the application of which a lens may be passed or rejected. Lenses are rejected also if they show

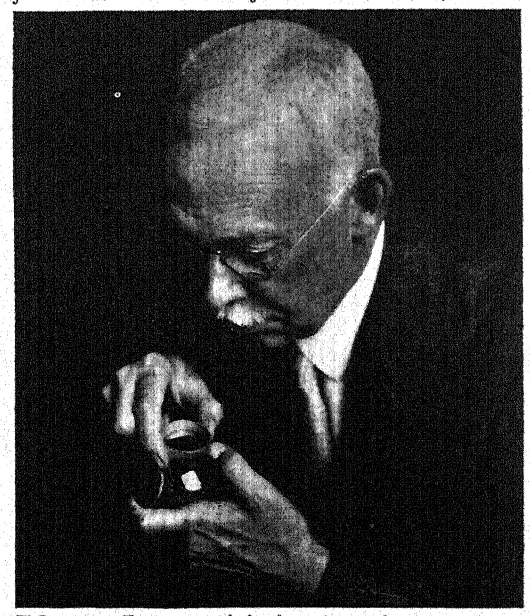


FIG. 11. Testing polished surfaces by "Newton's Rings." From Eastman Kodak

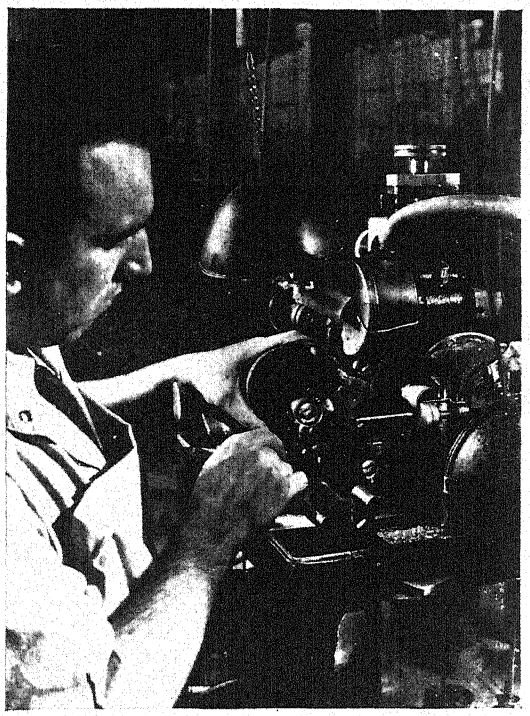


FIG. 12. Edging lenses to the correct diameter. From Eastman Kodak

signs of too much decentration or tilting of the elements.

LENS SPEED

It can be shown from the theory of geometrical optics that the illumination projected into the image formed by a well-corrected lens upon a photographic emulsion, depends *only* on the intrinsic brightness of the object being photographed, the cone-angle of the imaging rays, and the transmission factor of the lens itself. This relationship is perhaps best represented mathematically as follows:

In Figure 16, a well-corrected lens is shown forming an image of a small flat object having a brightness B (candles per square foot). If the lens transmits a fraction k of all the light incident upon it, we find that the image illumination E (measured in foot candles) is given by:

$$E = k \pi B \sin^2 \theta$$

Here θ is the slope-angle of the ray emerging from the extreme edge of the lens aperture and proceeding towards the center of the image. The symbol π is a constant, equal to 3.14.

When photographing a very distant object, as in landscape photography, the image falls at the "focal point" of the lens, and then the value of sin θ used in this equation is equal to $d/2f$, where d is the diameter of the lens aperture and f is the focal length. Since only the ratio of d to f is involved, it has become customary to express the speed of a lens in terms of its f-number which is the ratio of the focal length to the clear aperture. Thus, f-number is equal to f/d, and our image illumination formula becomes:

$$E = \frac{k \pi B}{4 \text{ (f-number)}^2}$$

Thus, if we stop a lens down from f/4 to f/8, we find we have only one quarter of the illumination on the film, requiring 4 times the exposure time in order to give the same density on the emulsion.

A most important conclusion from this relation is that the speed of a lens of a given f-number is independent of its focal length. Thus, an f/4.5 lens of 6 inches focus has the same speed as an f/4.5 lens of 3 inches focus. The speed is also independent of the distance of the object. Hence, if a person standing 25 feet from the camera requires 1/10 second



FIG. 13. Cementing a doublet lens. From Eastman Kodak

exposure, the same exposure will be required if he moves to 50 feet or 10 feet away. The reason for this is that a remarkable compensation exists between the light received by the lens and the size of the picture formed by it. To be sure the lens will receive more light from a person at 25 feet than from the same person at 100 feet. But in the first case, his picture will be 4 times as large on the film as in the second case. Thus, the increase in light is exactly offset by the increase in picture size, resulting in an unchanged intensity of illumination on the film, thus requiring the same time of exposure.

It may be of interest to include here a table connecting the f-number of a lens with its effective speed. We shall arbitrarily assign a speed of unity to an aperture of f/16, and we shall consider two values of the lens transmission k, namely 1.0 and 0.6. As shown more fully in Table I, the latter value corresponds approximately to familiar types of lenses having 8 free glass-air surfaces.

relative speed R, the f-number N, and the transmission k, are connected by the formulas:

$$R = 256k/N^2, \text{ or } N = 16\sqrt{k/R}$$

Variation of Lens Speed for Close Objects. When working with quite close objects, the lens-to-film distance must be increased to keep the image in focus and the effective f-number then becomes increased in the proportion of $(1+m)$, where m is the magnification defined as (image size) / (object size). With very close objects, the lens therefore becomes somewhat slower, and a longer exposure is required. The formulas given just above for relative speed, become, for near objects and finite magnification m:

$$R = 256k/N^2\,(1+m)^2, \quad \text{or}$$

$$N = \frac{16}{1+m}\sqrt{\frac{k}{R}}$$

Note that Table II indicates how this factor operates.

TABLE I. RELATIVE SPEED OF LENS

f-number	16	8	5.6	4.5	3.5	2.9	2.0	1.5	1.4
Relative speed for k=1.0	1	4	8	12	21	30	64	114	130
Relative speed for k=0.6	0.6	2.4	5	7	12	18	38	68	78

It is clear from this table that a normal f/3.5 lens with 8 glass-air surfaces will have no greater *effective* speed than an f/4.5 lens having perfect light transmission, if such a lens could be made.

To extend the above table to other apertures and speeds, it is worth noting that the

Variation of Lens Speed Over the Picture Area. The speed of a lens is unfortunately not uniform over the whole field, being greatest in the middle and falling off to the corners. This is caused by the "vignetting" or cutting of the oblique beams by the front and rear lens mounts (Fig. 17), and also by

TABLE II. VARIATION OF LENS SPEED WITH OBJECT DISTANCE

Object Distance in Multiples of Focal Length	∞	100	20	10	5	3	2	1.5
Magnification m	0	.01	.05	.11	.25	.50	1.00	2.00
$(1+m)^2$	1	1.02	1.11	1.23	1.56	2.25	4	9
f/3.5 Becomes Effectively f/	3.5	3.57	3.87	4.32	5.47	7.88	14	32
f/8 Becomes Effectively f/	8.0	8.16	8.86	9.87	12.5	18	32	72

the operation of the "$\cos^4\Phi$" factor. This factor is due partly to the longer path from lens to corner, partly to the obliquity of the light as it falls on the film, and partly to the elliptical view of the lens aperture as seen from the corners even when vignetting is absent.

These two factors, vignetting and the $\cos^4\Phi$ law, acting together may reduce the corner illumination of an otherwise good lens to a point as low as 15% of the central illumination. Any reduction below about 25% is, however, distinctly undesirable as it darkens the corners of the print noticeably.

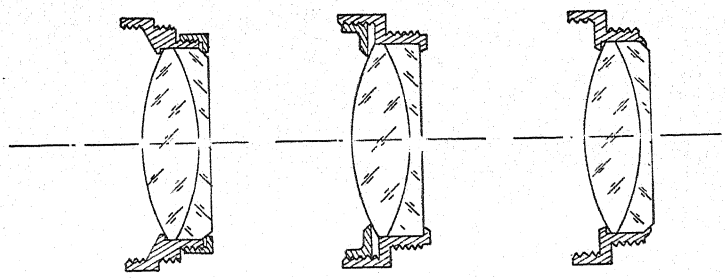


FIG. 14. Three typical lens mounts. Lens *a* has a screw-on piece inside the lens and *b* has a screw-on piece outside the lens

EFFECTS OF SURFACE REFLECTION

It is well known that a polished, clear glass surface reflects about 5% of the light incident perpendicularly upon it. Consequently, a photographic lens containing perhaps 8 glass-air surfaces will necessarily reflect a considerable percentage of the incident light back again towards the object, thus reducing the transmission factor *k*.

The rule for determining the over-all transmission of a lens is to multiply together the transmissions of all its surfaces. Thus, if each surface reflects 5% of the light incident upon it, it will have a transmission of 0.95 and the over-all transmission of a complete lens having *n* glass-air surfaces will be given by:

$$k = (0.95)^n$$

Some values of this factor are given in Table III below.

This lowering of the speed of the lens is one objectionable consequence of surface reflection, but unfortunately it is by no means the whole story. Light which has been reflected by the various internal surfaces proceeds back towards the front of the lens, and on its way it must necessarily traverse some of the other glass surfaces. As it strikes each of these, another 5% is reflected, this time back into the camera! We may argue that 5% of 5% is only ¼ of 1%, which is a very small fraction of the original light, but we

TABLE III
UNWANTED LIGHT IN LENSES
(Assuming 5% Surface Reflection)

Number of Glass-Air Surfaces	*Useful Light Transmitted (Per Cent)*	*Amount of Unwanted Light (Per Cent)*	*Ratio of Unwanted to Useful Light (Per Cent)*
2	90	0.2	0.2
4	81	1.2	1.4
6	74	2.5	3.4
8	66	4.0	6.1
10	60	5.6	9.4
12	54	7.3	13.4

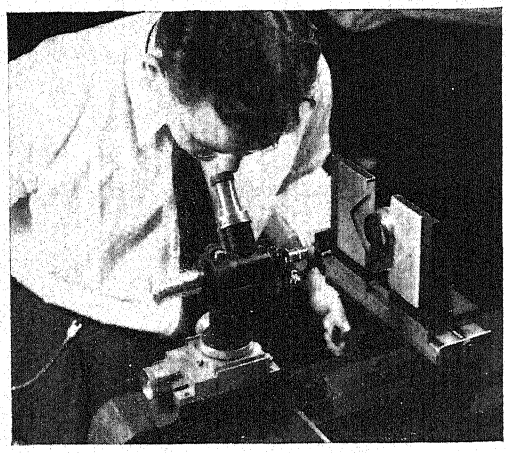


FIG. 15. Testing lenses by microscopic examination of the image. From Eastman Kodak

must realize that there are a great many possible sources of this doubly reflected light. An 8-surface lens, for instance, will yield no less than 7+6+5+4+3+2+1, or 28 beams of doubly reflected light, all progressing into the camera, and the total intensity of these beams may become surprisingly large, as is shown in Table III.

To make matters even worse, each of these 28 beams of doubly reflected light is caused by reflections from two well-polished spherical surfaces and, consequently, somewhere along the emerging beam there will be formed an image of every bright point of light situated in front of the lens. If these "ghost" images (so called because of their relative faintness) happen to fall close to the photographic emulsion, an unwanted faint image of the original object will be recorded in the picture. If the "ghost" is out of focus, each point of light in the object will be recorded as a patch of light having a shape similar to the shape of the iris of the lens. The reason for this is indicated in Figure 18.

An illustration of the formation of these out-of-focus "ghost" images is shown in Figure 19, representing a night photograph of a street scene. For this view, the photographer used a lens having 8 glass-air surfaces, all of which were concave to the diaphragm.

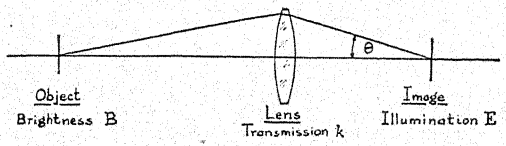


FIG. 16. The "speed" of a lens. For formula, see page 2285

A second phenomenon also appears as a result of internal reflections within a lens. Somewhere along every doubly-reflected beam there will be formed an image of the iris diaphragm aperture. Since the diaphragm itself is centered about the lens axis, its image will also be so centered, and the image may be real or virtual, large or small, and close to or far from the lens. In the example indicated in Figure 18, the image of the diaphragm formed by the double reflection is situated at I^1, where the reflected beam is symmetrically disposed relative to the lens axis. In this case, the diaphragm image is virtual and within the lens, and therefore, quite unimportant. A much more serious situation arises, however, if the diaphragm image caused by two internal reflections happens to fall outside the lens, and close to the film plane. In this case, especially at a very small stop, an image of the diaphragm itself may be projected on the middle of the picture area, causing a "flare spot." As there are many possible beams of doubly-reflected light, there may, of course, be many such central diaphragm images, but generally most of these are situated too far from the film plane to be significant. However, even if only one diaphragm image is in focus, the "flare spot" may be very trying. Since the flare spot is an image (possibly an out-of-focus image) of the diaphragm, its brightness will be substantially independent of the size of the diaphragm. However, the brightness of the background will increase rapidly as the diaphragm is opened, for which reasons a flare spot quickly expands and disappears from view as the diaphragm is opened up. A typical flare spot is shown in Figure 20.

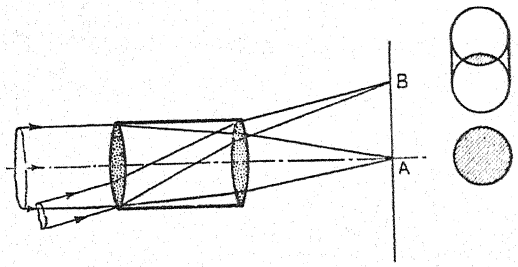


FIG. 17. Vignetting or cutting of the oblique beams by the lens mount

REDUCTION OF SURFACE REFLECTION IN LENSES

Within recent years various methods have been proposed for reducing the amount of surface reflection in lenses (see article on

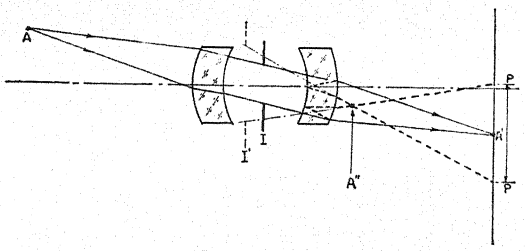


FIG. 18. The formation of an out-of-focus ghost image by double internal reflection without a lens. *A* is a bright lamp; *A'* is the desired image on the film; *A''* is an unwanted doubly-reflected image of *A*. *PP* is the patch of light formed on the film, having the same shape as the iris, *I*, and its image, *I'*. See Figure 19

Lenses With Surface Coating). H. Dennis Taylor discovered in 1895 that old lenses in which the surfaces had become tarnished to a blue color actually transmitted more light than newly polished lenses. He and others have since made innumerable attempts to produce a bluish tarnish deliberately by chemical methods, with somewhat doubtful success. Miss K. Blodgett in 1935 discovered a means of depositing a wax-like film of suitable material on glass, which, when made to the correct thickness, had the effect of eliminating almost all reflection from the glass surface. These films are extremely delicate and the method is consequently somewhat impractical. Professor John Strong, in 1936, published a description of a method he had developed by which a very thin film of a crystalline material could be evaporated and condensed on the glass, and this was found to be very effective in reducing surface reflections. The films first produced were fairly easily wiped off, but recent researches have indicated how films may be deposited which are robust enough to be cleaned and roughly handled.

The benefit to be derived from the use of these coated lenses is very great. For example, an 8-surface uncoated lens transmits only about 66% of the incident light to form the useful image, plus 4% due to multiple internal reflection within the lens. Hence, about 6% of the transmitted light is unwanted and definitely injurious. Even if no ghosts or flare spots happen to be formed on the film, the 6% of light is there in the form of general illumination over the whole picture, reducing contrast and concealing shadow detail.

By coating all the surfaces in this lens and thus reducing every surface reflection from



FIG. 19. Out-of-focus ghost images formed by internal reflections within a lens. See Figure 18

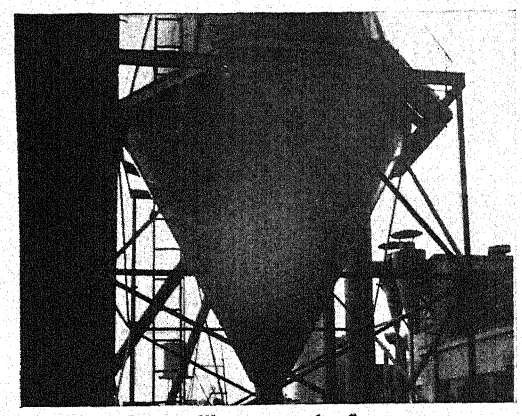


FIG. 20. Illustration of a flare spot

5% to perhaps 1%, these figures become:

Useful light transmitted	= 92%
Unwanted light transmitted	= 0.25%
Ratio of unwanted to useful light	= 0.27%

The benefit resulting from this surface treatment is obviously considerable.

OTHER SOURCES OF STRAY LIGHT

Unwanted or stray light in a camera may also be due to various causes other than internal reflections from the surface of the lens. For instance, a shiny area in the lens barrel, polished diaphragm blades, dirt on the surfaces, or small bubbles in the glass, may all contribute their share of unwanted light, and the camera manufacturer must see that light from such sources does not mar the picture.

RESOLVING POWER OF LENSES

With the present craze for small negatives which must be enlarged many times in making a print, the question of sharpness of definition or resolving power of a lens has come into considerable prominence. This is especially the case in microfile cameras for photographing a whole page of print on to a small fine grain film for convenience in storage or transmission through the mails, or to make copies of irreplaceable books or articles for distribution to a wide circle of readers. Suppose we examine with a microscope the image of a distant point of light or "artificial star" formed by the lens under discussion. On the lens axis, this star image will appear as a small circle of light, surrounded by a smallish faint halo of light. If spherical aberration is present, the halo may be large and decidedly bright, causing the well-known veil of haze which covers pictures taken by such a lens. Fortunately this effect is very uncommon in reputable anastigmatic lenses.

If we now move the point source of light away from the center, out into the field of the lens, its image will become larger and no longer circular. If astigmatism is present, for example, the image becomes elongated either vertically or horizontally, or it may take on a diamond-shaped appearance. Some halo may or may not be present. This enlargement of the star image causes a slight softening of the lens definition, and it represents, of course, a defect in the lens. In most good lenses, as the object point moves out into the field, the image becomes worse out to a certain angle and then improves again until at a point approaching the corners of the picture the image may be as good as on the lens axis. Beyond this "node," the image quality generally falls off very rapidly and the lens becomes useless. In Figure 21 is shown a typical series of star images, made with an f/4.5 anastigmatic lens, at every 1° interval of obliquity from the axis out to 23°. The "node" evidently appears at about 20° obliquity, beyond which the sharpness of definition rapidly deteriorates.

When a lens is stopped down, all these star images become reduced in size, and the halo is removed, so that a lens which is quite bad at, say f/4.5, may be entirely satisfactory at f/8 or f/11. It is often asked how far a lens must be stopped down to reach its best definition. The answer is that the further it is stopped down, the better it is likely to be, until about f/22, after which diffraction of light at the lens aperture tends to *enlarge* the image point as the lens aperture is further reduced (see page 779). It should be remembered that at the same time, the speed of the lens becomes progressively less as the aperture is reduced. Hence, we generally find that the best compromise between improved definition on the one hand and reduced speed on the other hand is reached at a stop equal to about half the maximum aperture of the lens. This should not be taken as a rigid rule, but only as an observed tendency in many types of lenses.

There is, of course, an assignable tolerance to the size of a star image formed by a lens as described above. If we are proposing to view a direct contact print from a distance of 10 inches, a star image less than 1/100 inch (0.25mm) in diameter will be scarcely distinguishable from a point. If the same print is viewed by a near-sighted person from a distance of 5 inches, he may complain of a slight softening of the definition under these conditions, and will demand a tolerance of only about 1/10mm for the size of an image point.

Consequently, to make any significant numerical statements as to lens definition, we must specify that the print shall be looked at from a fixed distance, preferably from its correct center of perspective. In this case, the permissible size of an image point will be between 1/1000 and 1/2000 of the focal length of the lens.

If a lens formula is worked out by the designer, and two lenses are made to this formula, one in a 10-inch focal length and the other in a 2-inch focus, then at any given obliquity, the size of the star image formed by the first lens will be 5 times as large as the corresponding image produced by the second lens. If the negative taken with the 2-inch lens is then enlarged 5 times and the print compared with a contact print of the larger negative, no difference in sharpness should exist between the two pictures. The only difference, apart from focusing errors and a 5-times difference in the depth of field, will be the film graininess, which is of course 5 times as great in the enlargement as in the contact print. The latter difficulty is being met by the introduction of fine grain films, and the focusing problem by the more general use of coupled range finders on miniature cameras.

Within the last few years, the resolving power of a lens expressed as so many "lines per millimeter" has become a familiar term in photographic literature. The meaning of this is that, using a certain specified emulsion, exposure, and development conditions, the photographed image of a chart marked with parallel black lines separated by equally broad spaces is just recognizable as consisting of lines, and is on the verge of appearing like a uniform gray surface.

By suitable controlled experiments, it is possible to measure the resolving power of any given lens-film combination. The lens contributes its share to the resulting resolution limit, because of the finite size of the star images formed by the lens. The film also contributes its share because of the finite graininess of the emulsion and by light scatter in the emulsion which tends to expose the clear spaces between the lines of the resolution test chart. If we use a very good lens such as a telescope objective, then the resulting resolving power will be due almost wholly to the film; on the other hand, if we use an exceedingly fine grain film with a rather poor photographic lens, then the lens is almost entirely responsible for any lack of resolution. The midway case, when the inherent resolutions of lens and film are comparable, is more difficult to interpret, and requires very careful experimental technic to obtain measurements which are significant. Such specialized tests are not recommended for the inexperienced worker.

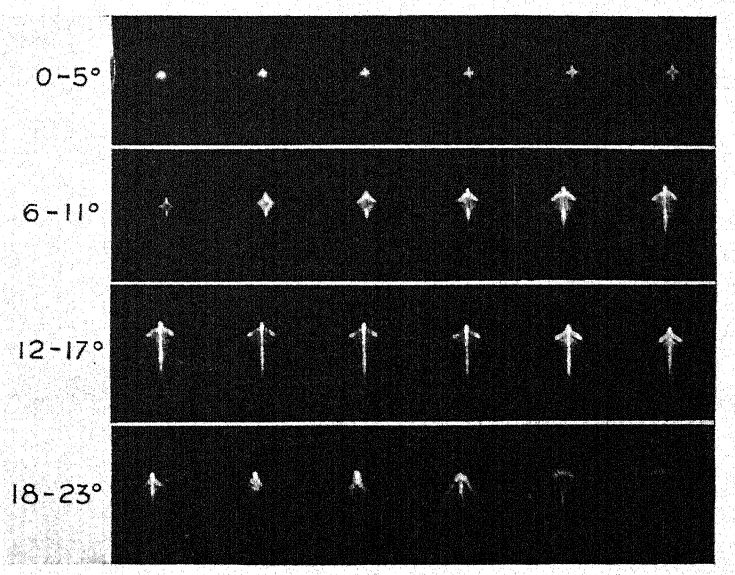


FIG. 21. Star images formed by an f/4.5 anastigmatic lens with covering power of 21°. Resolving power of the lens is illustrated

SIMPLE LENS FORMULAS

A few formulas connecting object and image distances with the focal length and magnification of a lens are sometimes useful. These are given here, using the symbols:

s = object distance from lens
s' = image distance from lens
f = focal length of lens
m = magnification

Then: $\frac{1}{s'} = \frac{1}{f} - \frac{1}{s}$. Hence $s = \frac{s'f}{s'-f}$;

$$s' = \frac{sf}{s-f} \; ; \; f = \frac{ss'}{s+s'}$$

$$m = \frac{s'}{s} = \frac{f}{s-f} = \frac{s'-f}{f} = \sqrt{\frac{s'-f}{s-f}}$$

$$s = f\left\{\frac{1+m}{m}\right\}; \quad s' = f(1+m)$$

$$f = s\left\{\frac{m}{1+m}\right\} = \frac{s'}{1+m} = \sqrt{(s-f)(s'-f)}$$

The distances S and S' are, strictly speaking, the distances of object and image from their respective nodal points in the lens. Similarly, the focal length of a lens is the distance from the nodal point to the focal point of the lens. If a lens is quite thin, the nodal points coincide at the lens, but if the lens is thick, the nodal points usually fall somewhere within it. In a telephoto lens, both nodal points fall at a certain distance in front. See page 1858.

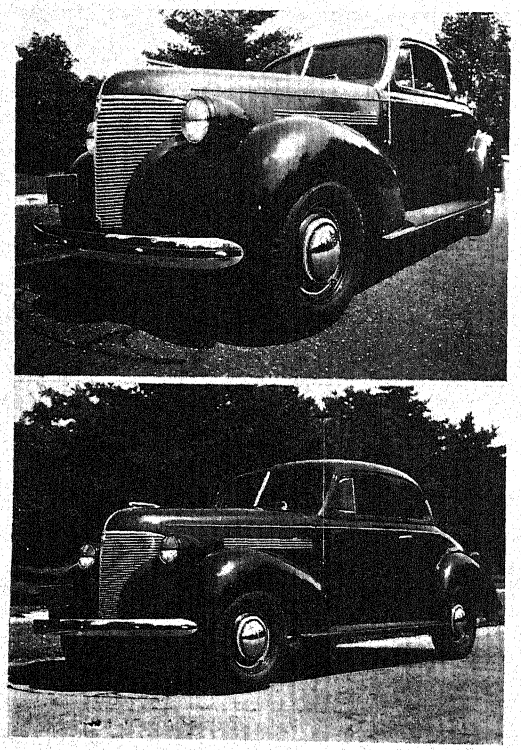


FIG. 22. Perspective distortion due to viewing a photograph from a point much further away than the center of the perspective

TELEPHOTO LENSES

The only reason to use a telephoto lens rather than an ordinary type of lens of the same focal length is that in the former the over-all length from the front surface of the lens to the image plane has been shortened to less than the focal length of the lens, whereas in ordinary lenses it is decidedly greater. The telephoto form of construction, namely a positive front component combined with a negative rear component, has the advantage of great compactness in the camera. However, it is impossible to design a telephoto lens which is either as fast or as well corrected as an ordinary lens, and consequently the telephoto type should be used only where compactness is desirable.

WIDE-ANGLE LENSES

The eye cannot take in at a glance a view wider than about 10° half angle, but by rolling the eye (unconsciously) a half field of as much as 25° can be comfortably explored. However, if we look at a picture covering a wider angle than about 25°, the eye refuses to regard it as really a wide-angle view, but unconsciously tries to interpret the scene as being of normal angular extent. Thus, we have an unconscious tendency to look at a wide-angle photograph from too great a viewing distance, resulting in an enhanced magnification of the foreground and of all close objects (Fig. 22). This makes a wide-angle view of a small interior such as the inside of an automobile look unnaturally wide and spacious. The effect disappears if the print is viewed from its true center of perspective.*

*The center of perspective of a photographic negative or of a contact print is at the position originally occupied by the center of the taking lens. In an enlargement the center of perspective is distant from the picture by an amount equal to the focal length of the taking lens multiplied by the enlargement ratio.



FIG. 23. Effect of tilting the camera upwards when using a wide-angle lens

An even worse property of a wide-angle lens is the drastic convergence of vertical lines which results when the camera is tilted up or down (Fig. 23). In Figure 24 three views of the same roof-line are shown, taken from the same viewpoint with the same camera, equipped with a wide-angle lens.

ENLARGING LENSES

Enlarging lenses differ from camera lenses in only one respect—namely, they are generally used to produce an image which does not differ in size very much from the film itself. To be sure, enlargements up to 10 or more times are commonly made, but these are generally of very small negatives, and for this purpose a regular camera lens may be used with complete satisfaction. Many "miniature" enlargers use the same lens as the camera with which the negatives were made. But for lower magnifications, especially around 1:1 to 3:1, an ordinary lens used at its full aperture is very likely to show a decidedly curved field and possibly other defects. The error can be minimized by stopping the lens down to f/8 or less, but it is better to use a lens which has been especially computed to work at a magnification of perhaps 3:1 or 2:1. Fortunately, enlarging lenses are usually required to cover a half-field angle of only about 18° or 20°, which helps the problem considerably from the designer's standpoint.

AVIATION LENSES

These fall into two types: those for map making and those for pictorial or military reconnaissance purposes. The mapping lens is used only in perfect weather, at an aperture of f/6.3 or f/8, or even less. However, distortion must be perfectly corrected over the entire field, and the lens should cover as wide an angle as possible to reduce flying time. Lenses of 8¼-inch focal length that cover a 9 x 9-inch picture have been extensively used, and recently the Topogon lens has been produced which covers a half field of 45°, Figure 4 (19). A 6-inch lens of this type covers a 9 x 9 picture, or a 12-inch lens covers an 18 x 18.

For military purposes, high lens and film speeds are essential, because observation planes fly very fast. Also a long focal length is desirable to enable the plane to fly high over the enemy lines and yet secure pictures in which fine detail is clearly visible. Lenses of 40- and even 60-inch focus have been used.

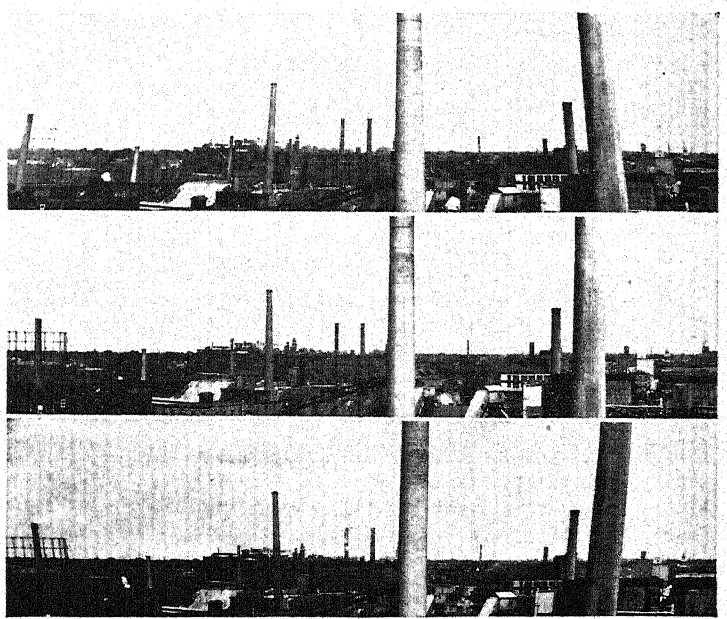


FIG. 24. Effect of tilting the camera upwards (above), holding it level (center), and tilting it downwards (below) when using a wide-angle lens

Distortion correction is not essential in such a case, but the definition must be excellent and the field must be flat. Recently, night photographs have been made from the air using flash bombs, and for this purpose lenses of the highest available aperture are needed.

PROCESS AND COPYING LENSES

Process lenses which are used mainly at about unit magnification (1:1) are usually of symmetrical construction, and commonly contain a separated positive and negative element in each half. They work at low apertures, from f/10 down, and have a focal length of between 12 and 24 inches. Lenses used for reproducing colored illustrations by a three-color separation process must be very perfectly color-corrected especially in regard to "lateral color," or chromatic difference of magnification. Such lenses are often called apochromatic process lenses, to indicate their exceptional degree of color correction. In these lenses, distortion must be non-existent, and the definition must be everywhere excellent over an 18° or 20° semi-field.

LENSES FOR AMATEUR MOVIES

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An elementary understanding of the function of a movie lens is important to every amateur cine photographer. Mechanical factors such as diaphragm openings and shutter speed are covered, as well as color correction, depth of field and hyperfocal distance, magnifying power, and field of view. Supplementary lenses and special lenses such as the wide-angle and telephoto are discussed and the various focal lengths for both 8mm and 16mm cameras are explained. Including a complete list of modern amateur cine lenses and their characteristics.

See Also Cine Equipment, Depth of Field, Extension Tubes For Cine Cameras, Lens Optics and Lens Types, Lenses

THE WORD "LENS," as applied to the cine or still camera is, strictly speaking, a misnomer. The correct name is "objective." A lens, in the true meaning of the word, is a single piece of glass ground with one or both surfaces to a curve which, when held a certain distance from a plane surface, will project an image (of sorts) onto that plane surface usually referred to as the film plane.

A photographic objective is a piece of equipment composed of two or more lenses (components or elements) which will project an image of varying degrees of fidelity, according to the type and manufacture. For convenience, however, we shall, in this discussion, refer to objectives as "lenses," and where necessary, to the various glass components of the lens as "elements."

Considering the lens as the eye of your camera, it should follow that the best results will be gotten through the use of the best obtainable lens. Careful consideration should be given, if one cannot afford to buy the best, to making a choice of the next best. Generally speaking, we can consider that lenses placed on the market by reliable manufacturers will quite fulfill the claims of these manufacturers. One thing we would like to stress is that there has long been a feeling that European lens manufacturers were better able to turn out a finer lens than American manufacturers. That might have been true in the early days of photography, but it is not so today. The most significant improvements and changes in lens manufacture today are those made right here in the United States. This has been true for a number of years. Our American manufacturers of photographic objectives have made such tremendous strides in the science of optics that most European lenses rate, at best, a fair second. This need not be considered a patriotic statement, but a statement of fact borne out by their use in cameras.

There are several things to be considered in making the choice of a cine lens.* They are color correction, focal length, universal or focusing mount, speed, and general adaptability. Let us examine these factors, but not necessarily in the order given.

* Cine lenses and lenses for still cameras are not fundamentally different. The optical problems and the solutions, in other words, are much the same for both the still and movie camera. In fact, some—like the Contax and Leica lenses—are actually interchangeable with certain cine cameras. In general, then, information given on the subject of still lenses (see articles on *Lens Optics* and *Lenses*) will apply as well to cine lenses. All cine lenses, however, are compound and none are as uncorrected as the single meniscus. All have diaphragms within the lens and none have between-the-lens shutters. In general, too, it may be said that cine lenses are fast, since they must expose at at least 1/30 second under many light conditions.

COLOR CORRECTION

The degree of color correction of a lens is a very important item, and although the term is very widely used, it is perhaps one of the most misunderstood terms in amateur photography. A lens being color corrected does not mean that that lens will photograph, by some mysterious quality, the colors of a scene in black and white in the same intensity as they appeared to the eye. Within the limitations of the film and the correctness of the exposure, any lens will photograph each color as it "sees" it, in varying degrees of grays. That is, black will photograph as black, blue will appear in a certain shade of gray, green in another shade of gray, and so on. Color correction, however, is that property of a lens which enables it to photograph all colors with the same degree of sharpness.

Most of us know that white light is made up of all colors of the spectrum, and that all colors are of different wave lengths. At one end of the spectrum we have red, that color of the longest wave length, and at the other end we have blue, that color of the shortest wave length. Between these two extremes are the other colors, each of a different wave length.

If this is so, let us take the following broad illustration. The American flag is being photographed. On focusing the lens, we find that the blue of the field is sharp, but the red stripes are out of focus. When we focus the lens to sharpen the red stripes, we find that the blue field is now out of focus. When the lens is focused on the field of blue, the red, having a longer wave length than the blue, will come to focus somewhere *behind* the film; and likewise, when we focus on the red stripes, the blue being at the *short* end of the spectrum, will come to focus at a point *before* the film. The result of this will be a picture out of focus (Fig. 1). (Note: if we had a lens like that we would possibly keep it as a curio, as no lens is as poorly corrected as the illustration would have us believe.)

This phenomenon of difference in wave lengths of various colors was a problem which had to be overcome by the makers of lenses if they were to give us a piece of equipment which would enable us to make

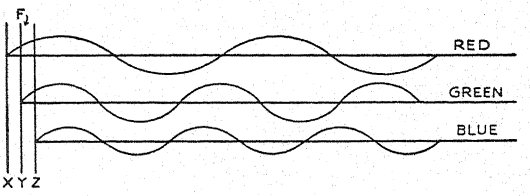


FIG. 1. Demonstrating exaggerated chromatic aberration. *F-Y* is the film, *X* is the plane in which red comes to focus, *Y* is for the green, *Z* is for the blue

sharp pictures consistently. By combining two or more glasses of different densities, they were able eventually to construct a lens which would focus all colors to the same plane. The reason for using glasses of different densities was to provide some means of slowing down certain of the waves to the same "speed" or period as the others, thereby causing all waves to reach the same point at the same time.

Thus, when we say that we have a lens of high color correction, we mean that all colors of the spectrum, of which white light as we know it is composed, will come to a focus in the same plane. As a result of this color correction, we then have a picture which is in focus over its entire area. All good anastigmatic lenses have a high degree of color correction and, for the average use of the amateur, it can be said that most lenses today are of sufficient color correction.

Kodachrome. There is one more angle that we should like to discuss before leaving the matter of color correction, and that is the use of Kodachrome. With Kodachrome, a lens possessing a high degree of correction should be used, for it is here that all colors *must* come to focus in the same plane to produce a picture of uniform sharpness. When Kodachrome is used in a camera equipped with a poorly corrected lens, the pictures are soft and do not possess that crispness of detail so marked in a film made with a fine lens.

MECHANICAL FACTORS

In making movies, there are certain mechanical factors in conjunction with the use of the lens that we must learn about. These are focus and diaphragm setting, and in some movie cameras the shutter must be or rather can be taken into consideration. We shall for the time being concern ourselves only with the first two of these factors, for in most movie cameras the shutter remains at

the same opening and therefore does not have to be adjusted.

Diaphragm (Iris). *The Dictionary of Photography* (Wall) explains the word "diaphragm" as follows: "From the Greek . . . partitions, also called stops, are the partitions of a lens with varying apertures which permit a greater or lesser amount of light to pass through the lens." This partition is called the iris diaphragm. This iris is adjustable so that the light entering the lens may be controlled to a certain degree. We all are familiar with the iris of the eye. When the light is strong, the pupil, due to the closing of the iris (diaphragm), becomes smaller, and when the light is poor or weak, the iris opens wider and the pupil becomes larger in diameter, thus allowing more light to pass to the retina, which corresponds to the film in our camera.

Diaphragm Setting. On examining the lens, we find that about half-way between the front and rear ends of the lens there is a ring that is moveable. This ring is the exterior control of the iris. By means of this ring we can control the amount of light that passes through the lens on its way to the film. We find also that engraved in close proximity to this ring is a series of numbers, some of which have decimal places. These numbers indicate the opening or rather the diameter of the iris when the indicator is placed opposite a chosen number. These numbers are known as "stops." From this term we derive the expression, "to stop the lens down." At this point, the lens has been set according to chart or meter to give the correct exposure. Here are the stop numbers or f-values in most common use today: *f*/1, *f*/1.4, *f*/2, *f*/2.8, *f*/4, *f*/5.6, *f*/8, *f*/11, *f*/16, and *f*/22. These are the most commonly used half stops: *f*/3.5, *f*/4.5, and *f*/6.3.

Lenses are generally known by the number of their widest stop. Thus if a lens is wide open at *f*/3.5, we call it a "three-five lens." Please note here that the larger the number or value, the smaller is the diaphragm opening, and, inversely, the smaller the number or *f*-value, the larger the opening.

This scale of diaphragm stops was arranged by the International Congress of Photography in Paris in 1900, so that each stop admits 100% more light than the next succeeding stop. From this we can conclude that when a lens is set at *f*/2.8, 100% more light is being admitted to the film than if the lens were set at *f*/4, and so on through the entire scale. On this basis, each stop doubles the amount of light admitted by the next smaller one (since the stops are arranged in geometrical progression), so that *f*/2 admits four times as much light as *f*/4. Photographically speaking, we say that *f*/2 is four times as fast as *f*/4 (see *F-Number* article).

SPEED

As there is no actual motion involved in a motion picture camera lens, the word speed is not too well advised, although it is in common use. We refer to a lens as a "fast" lens if it has for its largest opening or greatest aperture the designation of *f*/3.5, 2.8, 1.5, or any of the variants of these numbers such as *f*/2.7, etc. Although we shall not concern ourselves with the actual calculations, we should know that there is a direct relation between the *f*-number or value and the focal length and the diameter of any aperture at which we happen to set the lens diaphragm.

On some lenses we will find an *f*-value of 2.7 or others that do not appear in the standard scale of *f*-values. This is because the manufacturer or designer of the lens, in the effort to allow a little more light to pass than if the lens were calculated on the standard scale, found that, by a slight modification of the basic design, this could be accomplished. Hence the lens with its highest value at *f*/2.7, allows just a bit more light to pass than the lens rated at *f*/2.8. In the exposure there is a slight difference, that is not noticeable in the final results due to the automatic compensation during the redeveloping process. It does give one a slight "edge" over a lens which is marked in the next higher figure: i.e., 1.4 over 1.5, or 6.3 over 6.5. If there is a choice to be made and the lens with the slightly smaller aperture is of a better make, disregard the fact that the other is ever so slightly faster, and choose the slower one.

There is one very important point to remember—that these figures have the same value no matter what lens they apply to.

(*Continued on page 2297*)

LENSES FOR AMATEUR MOVIES
(continued)

If a lens whose greatest aperture is *f*/3.5 is set at this value, then a lens whose largest opening is *f*/1.5, when stopped down to *f*/3.5, allows no more or no less light to pass than the *f*/3.5 lens when it is wide open. Therefore you will see that a different exposure meter or exposure chart is not needed for lenses on the *same* camera. However, different calculations are needed for different cameras and this will be discussed in the section devoted to shutter speeds.

CORRECT FOCUSING

Cine lenses are supplied in two general types, i.e., those with focusing mounts and those of universal focus. This latter is often called "fixed focus." Broadly speaking, they can be taken to mean exactly what the name implies. Universal focus means that a lens, to produce a sharp picture on the film, needs no adjustment for distance from the subject, while, on the other hand, a lens in a focusing mount must be set.

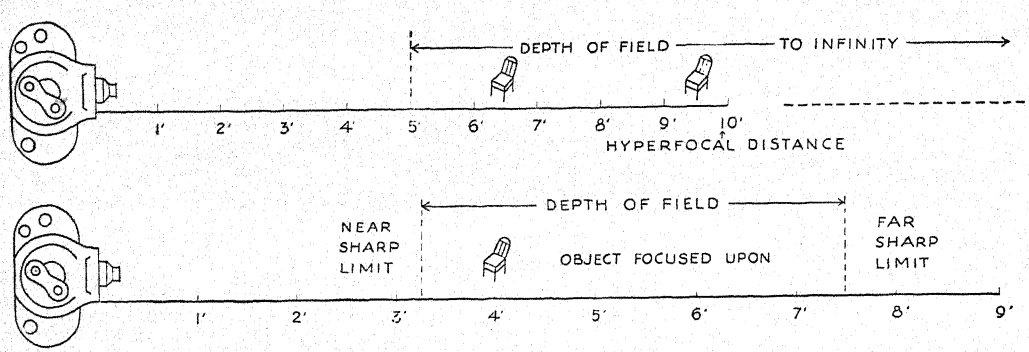
Hyperfocal Distance. While there is no adjustment necessary in the focusing of a fixed-focus lens, there is, at the same time, a definite relationship between the lens stop and the various distances at which your camera may be set up from the subject and still have other objects in sharp focus. This distance is variable and is called the hyperfocal distance (for definition, see page 1226). Hyperfocal distances are controllable to a certain degree, depending on the stop in use. The smaller the stop used, the closer the camera can be set to the subject and still have that subject and all subjects beyond this hyperfocal point in focus.

By referring to Table I, we see that each lens has a definite point at and beyond which all objects will be critically sharp. Also note that at these various points or hyperfocal distances, there is a definite *f*-value. For example, a 1-inch lens stopped down to *f*/5.6 has the hyperfocal point at 14¾ feet. A subject at this distance from the camera will be in focus and all subjects beyond this point will also be in focus. An interesting fact should be taken note of and that is, for average movie work, this hyperfocal distance can also be divided by two and the result will be the close working distance from the camera. If the hyperfocal point is 14¾ feet, an object placed at half this distance, 7

TABLE I
FILMO LENSES—HYPERFOCAL DISTANCES (In Feet)

Lens Focal Lengths	*F-Values*													
	1.5	1.8	2.0	2.5	2.7	3.5	4.0	4.5	5.6	8	11	16	22	32
12½mm	131½	111½	10	8	7½	5¾	5	4½	3½	2½	1¾			
15mm				11¼	10½	8	7	6¼	5	3½	2½	1¾		
20mm				26½	24¼	19	16½	14	9¼	6½	6	4		
1-inch	55½	46¼	41¾	33½	30¾	23¾	20¾	18½	14¾	10¾	7½	5¼	3¾	
1½-inch				75	69½	53½	46¾	41¾	33½	23½	17	11¾	8½	
2-inch	222	185	167	133	123	95	83	74	60	42	30	21	15	11
3-inch				300	278	214	187	167	134	94	68	47	34	23
4-inch				533	494	381	333	296	238	167	121	83	60½	42
6-inch				1200	1100	857	750	667	536	375	273	188	136	94

Note: Hyperfocal distances for lenses for Filmo 16mm and 8mm cameras, are expressed in feet and based upon a circle of confusion of .001-inch diameter, which makes the table suitable for very critical work. For average work with 16mm film, a .002-inch circle of confusion can be used. This would halve every hyperfocal distance.



FIGS. 2 and 3. Above, depth of field is shown by these Bell & Howell diagrams. With a 16mm Filmo 1-inch Focusing Mount lens set at f/4 and focused at 10 feet (hyperfocal distance), above, everything from infinity to half that distance (5 feet) will be in satisfactory focus. Below, a 16mm Filmo camera is shown here focused at 5 feet, when lighting conditions called for a stop of f/5.5. Focused at 5 feet, the depth of field was from 3¼ to 7½ feet

feet 4 inches, would still be in acceptable focus. The resulting picture would roughly be .001 times less sharp than if the hyperfocal distance were used.

By again referring to the table of hyperfocal distances, we find that by stopping the lens down, light permitting, we can shorten the hyperfocal distance, or bring it closer to the camera, and in that manner make those oft-desired close-ups. By applying the halving rule, we can use the 1-inch lens, stopped down to *f*/22, as close as 2 feet 3 inches, and still get an acceptable picture. However, for extremely critical work the camera should never be used at less than the hyperfocal distance.

FOCUSING MOUNT LENSES

In using the lens equipped with a focusing mount, we can approach our focusing problem from three different angles.

By setting any lens at infinity, which point is indicated by the letters "INF" or "O" or by the figure "8" written horizontally, (∞), the lens may be used as a fixed or universal focus lens. In this case the table of hyperfocal distances will be found applicable.

A very interesting property of a lens may be employed in the following manner. By setting the focusing ring at the hyperfocal distance for the diaphragm stop called for, all objects from half this distance to infinity will be in focus. If you are using a 1-inch lens and the lighting conditions call for a stop of *f*/4, by referring to Table 2 we find that by focusing on the hyperfocal distance, which for average work we will consider as 10 feet, it will be seen that everything from 5 feet to infinity will be in focus (Fig. 2).

Direct Focus Method. The most common method of focusing used is the one whereby we focus directly upon the subject (Fig. 3) and then stop the lens down to conform with the lighting conditions. If the exact distance at which we are shooting is not marked on the lens, we then choose the next closest figure to it. It is better, however, to set the lens at the closest approximate estimate, between the marks indicating one above and one below the actual distance. To make this a little more distinct, we wish to set the lens at a distance of 8 feet. We find that there is no indication of 8 feet on our scale but there are both 6 feet and 10 feet. By setting the indicator on the focusing ring about halfway between these two marks, we will be set close enough to 8 feet for our purpose.

DEPTH OF FIELD

An interesting feature of a lens is that known as depth of field, sometimes called depth of focus. Depth of field is the correct term, however, as depth of focus refers to the *film* position tolerance (Fig. 4). These terms are very often misused and should never be confused, one with the other. See diagram on page 780.

Depth of field refers to the distance between two points—one nearest the camera and the other farthest from the camera—between which objects will be in focus. (The term "sharp focus" has been dropped indicating that focus should always be con-

sidered as "sharp." A picture is either in focus or not.) By referring to Table I, we find that a Universal Focus lens has a depth of field equal to the distance from its hyperfocal distance to infinity (Fig. 5).

When using a focusing mount lens focused on *infinity*, the depth of field is the same as that of a U.F. lens—hyperfocal distance to infinity. We have learned that, by stopping the lens down, we increase the hyperfocal distance and bring objects that are closer to the camera into focus. Bearing this fact in mind, let us see what happens when we apply this same principle to a focusing mount lens.

Suppose we have a subject 10 feet from the camera and we wish to focus directly on this subject without having near and far objects in focus. We set our focusing ring at 10 feet, stop the lens down to the required *f*-number, and, by knowing what the depth of field is, can then shoot our picture without

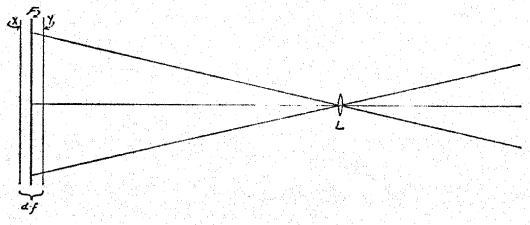


FIG. 4. Depth of focus (X-Y) refers to the position tolerance of the film with reference to acceptable sharpness and should not be confused with depth of field

having disturbing objects in focus. We see from Figure 3 that this depth of field has definite fore and aft boundaries known as the near sharp limit and the far sharp limit. Within these limits all objects will be in focus, as above mentioned.

There are tables showing these depths of field, but it would not be feasible to include them here. Such tables can be had from the manufacturer of the various lenses, and it should be borne in mind that tables issued by one manufacturer for a 1-inch lens, for example, can be used in conjunction with a 1-inch lens of another make. It is not possible to interchange tables of depth of field from one focal length lens to one of different focal length, however. (See *Depth of Field* article, page 1226.)

For those who care to figure the depth of field for themselves, the following formula is given. It is based on two known factors, namely the hyperfocal distance and the distance focused on. We now have:

h = hyperfocal distance
d = distance focused on

We then combine these two known factors into a formula which reads

$$\frac{h \times d}{h + d} = \text{near sharp limit or point closest to camera}$$

We then use the next formula which is a modification of the above as,

$$\frac{h \times d}{h - d} = \text{far sharp limit or point farthest from camera}$$

Translated into figures, we have,

h = 14¾ feet
d = 5 feet

Therefore we apply these figures to the formula as,

$$\frac{14\frac{3}{4} \times 5}{14\frac{1}{4} + 5} = \frac{73\frac{3}{4}}{19\frac{3}{4}} = 3\frac{1}{4}'$$, point closest to camera

$$\frac{14\frac{3}{4} \times 5}{14\frac{3}{4} - 5} = \frac{73\frac{3}{4}}{9\frac{3}{4}} = 7\frac{1}{2}'$$, point farthest from camera.

If we subtract 3¼ from 7½, we find that we have a working space of 4¼ feet wherein all objects will be in focus. This means that persons within these limits of sharpness may move around and yet remain in focus. The foregoing applies to any lens that is being used. So much depends on good focus, that it would be well to study this section carefully.

SHUTTER SPEEDS

Before we begin to discuss shutter speeds and their relation to the lens, let us review a simple fact in connection with motion pic-

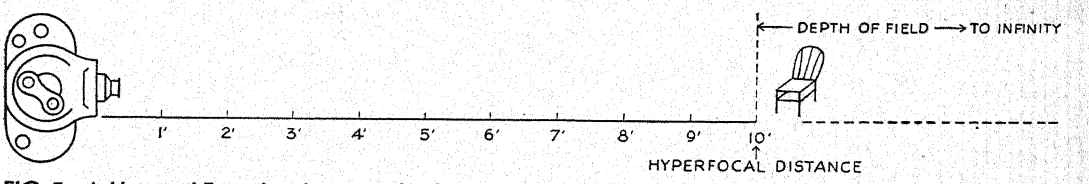


FIG. 5. A Universal Focus lens has as its depth of field the distance between infinity and the hyperfocal distance. This Bell & Howell diagram shows a 16mm Filmo with a Universal Focus 1-inch lens set at f/4

tures. When we see a motion picture on the screen, we do not see the actual motion, but merely the presentation of the illusion of motion as that motion was recorded by the camera. This illusion of motion is possible, due to the peculiar property of the human eye known as "persistence of vision."

What we actually see on the screen is a series of individual pictures presented in such rapid succession that we are aware of that illusion of motion. Because these pictures are projected in such rapid succession, we retain the image of each preceding picture long enough so that the next succeeding one which is projected comes before our eyes so quickly that we have not had time to lose the impression of the former picture. Hence we see what appears to be motion. Likewise, these individual pictures are made in such rapid sequence that hardly any phase of a movement or motion is lost. The camera records each phase of a cycle of motion in individual "snapshots." Upon the speed at which these individual shots are taken depends the effect we get on projection. The speed also determines the aperture at which the lens must be set to get the proper exposure. Each individual picture gets relatively the same exposure; the entire series, when projected, presents a pleasing whole as a well exposed film.

Speeds of Cameras. These shutter speeds, generally considered, are fractions of a second, just as they are in still cameras. As in a still camera we have to compensate for a change in shutter speed by making an adjustment in the diaphragm opening. In movie cameras of different makes, we have shutters which operate at different speeds. Upon these speeds the many exposures chart are calculated.

The list that follows shows the normal shutter speed at 16 frames per second for many makes and models:

Model	*Speed*
Cine Ansco Mod. B DeVry Filmo 70s Reg., 121 Filmo 8mm (all) Bolex Revere Univex Victor (all models) Zeiss Kinamo S-10-16	1/30 second
All Cine Kodaks except Cine Kodak Special (see below)	1/34 second
Cine Kodak Special	open—1/32 second ½ open—1/64 second ¼ open—1/128 second
Filmo Golf 70, 71s, 75 & 141 Keystone (late models A-3 & A-7) Keystone Model K-8, number 872650 and higher Simplex	1/40 second
Keystone (other models than above noted) Stewart-Warner 8	1/50 second

The above shutter speeds are given as being the closest standard shutter speed to that of the various cameras, i.e., 1/30 being the closest standard speed to the Filmo speed of 1/28 at which speed this camera is rated.

The reader might well ask what all this has to do with the lens on his camera. Each is so definitely bound to the other that to discuss one and ignore the other would be telling only half the story. All silent motion pictures taken for normal showing are made at the rate of 16 frames per second. That is, the film travels and the shutter opens and closes or revolves at such a rate as to expose sixteen individual frames each second. Each frame, in the cameras of the first group, receives 1/30 second behind the lens for exposure. That gives us a picture made at a definite diaphragm opening, at the speed of 1/30 second.

If we should change the speed at which the shutter rotates, we would effect a corresponding change in the exposure. Assuming that the normal shutter speed is 1/30 second and we wish to increase the speed of the shutter and the f. p. s.* to get a slow-motion result, we also *decrease* the exposure time. There is a strong relationship between these two factors. If we increase the camera speed to twice that of normal, that is 32 frames per second, instead of 16, we also automatically *decrease* the exposure time by 50%, resulting in 1/60 second. By doing this, each frame is behind the lens for only half the normal time, with resulting underexposure. If we make this change of camera speed without compensating for the loss of time of the film behind the lens, we get the above-mentioned *underexposure.* Since the individual frame is now getting half the amount of time behind the lens, it is reasonable to conclude that because of this, it is

*Feet per second.

receiving only half the amount of light. Therefore, some compensation must be made for this deficiency in light reception. This compensation can be made by opening the diaphragm a little wider than it was when we were shooting at normal speed. Consequently, since each stop admits twice as much light as the next smaller one, we make the compensation simply by opening the lens to the next larger stop. We have doubled the camera speed which resulted in halving the exposure time; but we have brought that exposure back to normal by doubling the opening of the diaphragm, thus doubling the amount of light reaching the frame.

Built-in Scales. Most cameras have a scale incorporated into them which will indicate the proper stop to use when a variation of the shutter speed is desired. The simplest way of determining the proper change to make is to first know the correct opening of the lens for the normal speed, 16 f.p.s. Then set the opening being used opposite this figure on the scale. By referring to the desired speed rating on the scale, we find near it the correspondingly correct stop for obtaining an exposure which would be correct for normal speed. Inversely, this is true when using speeds slower than a normal shutter speed.

Table II shows how this works out. Assuming that your normal exposure setting for the speed of 16 frames per second is *f*/5.6, set 16 (indicating film speed) opposite *f*/5.6, and you will see that at twice the speed (32 f.p.s.), one stop wider is indicated. Should we wish to use a shutter speed of 64 frames per second, we know that the exposure having been cut to 1/112 second (based on the actual Filmo speed of 1/28 sec.) or ¼ of 1/28, we must increase the exposure by four or by two stops.

The intermediate speeds will fall on the half stops. If these stops are not indicated on your lens, a point approximately halfway between the next highest and the next lowest will suffice.

FOCAL LENGTH IN RELATION TO MAGNIFYING POWER

The field which is included in a picture by a lens is governed by the focal length, which also governs the magnifying power. The perspective of the eye is so closely approximated by the 1-inch lens, that this lens has been adopted as the standard for 16mm motion picture cameras. (All reference to "the camera," will be taken to mean the 16mm camera.) We shall see that there is a definite relationship between lenses in regard to their focal length. A 1-inch lens will produce an image ½ the size of a 2-inch lens; likewise a 12½mm lens, which is considered standard for 8mm cameras, will give us an image half the size of a 1-inch lens. Just as this is true, so will a 1-inch lens on an 8mm camera produce an image twice the size of its standard or 12½mm lens. This will apply to lenses of all focal lengths when used on 8mm cameras.

To resume, if a 2-inch lens will give an image twice as large as a 1-inch lens, then a 3-inch lens will give us an image 3X the size of the 1-inch lens. As we progress in focal lengths greater than 3 inches, the same still holds true for each succeeding length. However, a lens of a focal length of 3 inches that we know will produce an image size three times that of a 1-inch lens, will, of course, produce an image of only 1½X that of a 2-inch lens. Our conclusion, gathered from the foregoing, should be this: if a 2-inch lens has the magnifying power of 2X, then a 3-inch lens has a power of 3X, a 4-inch lens a power of 4X, and so on with all our lenses.

TABLE II

F-stops					3.5		4.5		7				
	1	1.4	2	2.8		4		5.6		8	11.3	16	22
Camera speeds				64		32		16		8			
					48		24		12				

AREA OF FIELD

We now come to another characteristic of a lens, "area of field." This area of field compares with the area of vision of the eye, assuming that the eye is not being moved, but looking straight forward. It is the area within the horizontal and vertical extremes when these boundaries are projected from the lens. In other words, at various distances from the lens, there is a definite vertical and horizontal limit beyond which the lens will not "see."

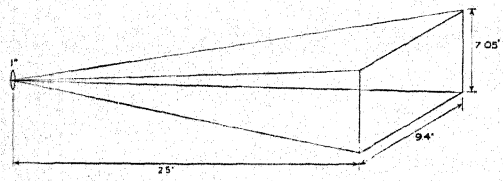


FIG. 6. Area of field is demonstrated in this diagram showing a 1-inch lens and a subject area at 25 feet distance. The area of field is 7.05 x 9.5 feet

By referring to Table III, we see that at 25 feet, a 1-inch lens "projects" a field 9.4 feet wide by 7.05 feet high. This is the field of a 1-inch lens at 25 feet, and all objects within those bounds (7.05 x 9.4) will be within the "vision" of the lens (Fig. 6). Let us illustrate this another way. By referring to Figure 7, we see that we have our camera set 25 feet from two posts that have been set in the ground. These posts are 9.4 feet apart, and the camera axis is at right angles to the middle of the line connecting the two posts. We start the camera and our subject starts walking towards post C, but does not enter the field of view of the lens until he is on the other side of the post, and will continue to remain in the field of view until he passes beyond post *D*. By substituting two objects which would not look out of place in our scene (indoors or out), we can in this manner set up boundaries for our "actors" to stay within, to assure us that they will be in the picture as long as we want.

Our depth of field formula or the hyperfocal table, will help us keep our subject in the picture as regards to focus. We now have five limits within which we can keep our subject: right or left of the camera line, near or far limit of sharpness, and height. The height of the picture, as you will note, is somewhat less than the width. The accepted format or shape of the motion picture is that of the rectangular screen as we know it.

It is of sufficient importance to note here that *depth of field* should never be confused with *field of view*.

Returning to the focal length, we now know that when using the 1-inch lens and including a definite field of view, the subjects upon projection of the picture will appear normal in size. We now substitute a 2-inch lens and, without changing the camera position, we have not only narrowed down the field of view, but have also *increased* the size of the image by 2X. We must remember that although we have

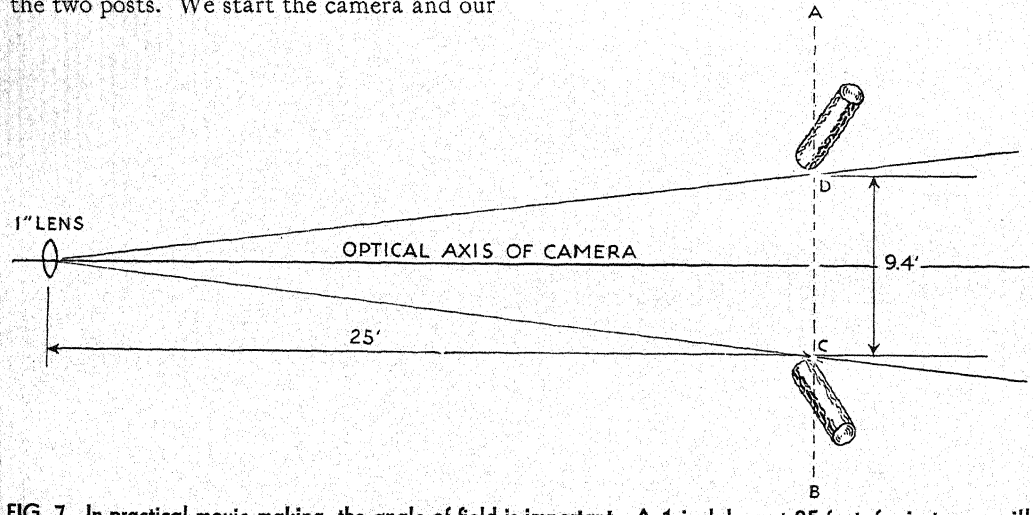


FIG. 7. In practical movie making, the angle of field is important. A 1-inch lens at 25 feet, for instance, will have an angle of view as explained in Figure 6 of 9.4 x 7.05 feet. Subjects who move about between posts C and D will be in the field

decreased the size of the field by the above change, we do however occupy the *entire* area of the frame. Figure 8 not only indicates the relative sizes of fields for various focal lengths, but also indicates the increased image size in relation to the field of the longer lenses and also the entire frame.

Table III shows the comparative sizes of field, in both the horizontal and vertical, for lenses from 15mm focal length to 6-inch focal length. There is one point here to take particular notice of, and that is, while a 15mm lens on a 16mm camera is considered a wide-angle lens (one that includes a wider angle than normal), on an 8mm camera, the same focal length is about normal. This variance exists between all lenses of different focal length.

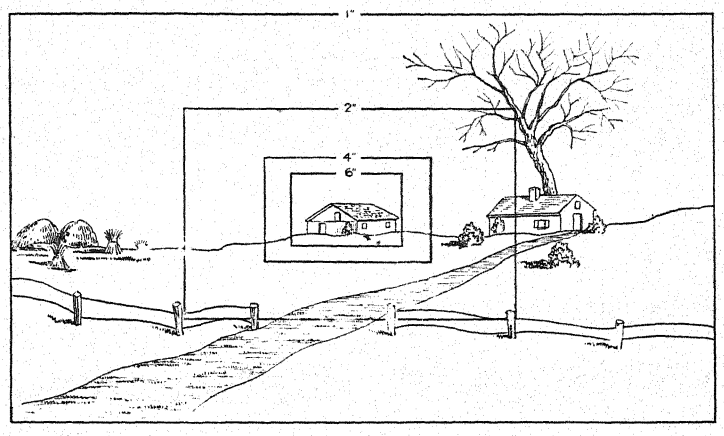


FIG. 8. Lenses of different focal length have varying field of view sizes. In this Bell & Howell diagram the outside area is covered by a 1-inch lens, the next by a 2-inch lens, then a 4- and 6-inch lens. The 6-inch rectangle as shown, of course, represents the full screen and because it is smaller than the 1-inch rectangle in the diagram does not mean that the 6-inch lens gives a smaller image frame. It gives, in fact, a *larger relative image*—for with the 1-inch lens the house is a small part of the frame, while it occupies the entire 6-inch frame

WIDE-ANGLE LENSES

If we were shooting a picture and some of our scenes are to be made indoors, it is quite obvious that we would not have the

TABLE III

FILMO LENSES—FIELD OF VIEW

Lens Focal Length		*Plane*	*Angle*	*Distance From Camera in Feet*									
8mm Camera	*16mm Camera*			1	2	3	4	5	6	7	8	9	25
	15mm	Horizontal	36°-6′	.64	1.27	1.91	2.55	3.18	3.82	4.46	5.10	5.73	16.1
		Vertical	27°-6′	.47	.95	1.42	1.90	2.37	2.85	3.32	3.80	4.27	12.0
12½mm	1 in.	Horizontal	21°-22′	.38	.75	1.13	1.51	1.88	2.26	2.64	3.01	3.39	9.4
		Vertical	16°-9′	.28	.56	.84	1.12	1.40	1.68	1.96	2.24	2.52	7.05
1 in.	2 in.	Horizontal	11°-4′	.19	.38	.56	.75	.94	1.13	1.32	1.50	1.69	4.7
		Vertical	8°-14′	.14	.28	.42	.56	.70	.84	.98	1.12	1.26	3.52
1½ in.	3 in.	Horizontal	7°-20′	.13	.25	.38	.50	.63	.75	.88	1.00	1.13	3.13
		Vertical	5°-26′	.09	.19	.28	.37	.47	.56	.65	.75	.84	2.34
2 in.	4 in.	Horizontal	5°-30′	.09	.19	.28	.38	.47	.56	.66	.75	.85	2.35
		Vertical	4°-5′	.07	.14	.21	.28	.35	.42	.49	.56	.63	1.76
	6 in.	Horizontal	3°-40′	.06	.13	.19	.25	.31	.38	.44	.50	.56	1.59
		Vertical	2°-43′	.05	.09	.14	.19	.23	.28	.33	.37	.42	1.18

Note: For camera distance from 1 to 9 feet, read the above table direct. For greater distances, simply move decimal point. Example: Area width for 1-inch lens on a 16mm camera is 2.26 feet at a distance of 6 feet. At 60 feet it would be 22.6 feet; at 600 feet it would be 226 feet.

same space or distance to use as we did when we were outside. We then have to work at shorter distances from our subjects, and normally we might find the 1-inch lens too long for this purpose. It is then necessary to bring the *wide-angle* lens into use.

A wide-angle lens, as its name implies, is one which has a shorter focal length and covers a wider angle of view than a standard lens, and therefore has a wider field of view. While a 1-inch lens has a horizontal field of view of 9.4 feet at 25 feet from the camera, a wide-angle lens at the same distance would include 3.3 feet more on either side. This wide-angle lens is not generally used at this great distance, but the lens has a definite place in cine photography.

Let us examine a sample shooting script of the picture we are making. We find that the first shot indoors calls for a medium long view of a couple seated at the radio. The average person seated in a chair is about 4 feet 4 inches high. We must include the head and feet of the actors, so according to Table III we find that if our camera is placed 18 feet from the subjects, we include a vertical field of about 5 feet 6 inches. Our room, however, does not permit us to back away from the subjects the 18 feet required, so we will use our wide-angle lens. Again referring to Table III, it is found that to obtain a 5-foot vertical we need retire only 12 feet from the subject to get the needed full figures. We do, however, get the same size image on the film at 12 feet with the wide-angle lens as we would have gotten 18 feet from the subject using the 1-inch lens.

LONGER FOCAL LENGTHS

The script now calls for a close-up of the two people at the radio, and we shall see why it will not be necessary to move the camera nearer them. The problem here is to photograph the heads of the actors so that, on projection, these heads will fill up the screen area. In making a close-up, it is desirable to eliminate as much from the picture as possible. This means that we must narrow down the field of view, and we accomplish this by using a lens of longer focal length. For our purpose the 2-inch lens will do. By using this lens, we have not only narrowed down the field of view to our requirements, but we have also increased the image size by 2X.

Our actors are seated close to each other, and we then have them each incline his head toward the other, and we find that the total space occupied by the two heads is about 2 feet wide. Table III shows that by retaining the same camera distance (12 feet) we can cover the 2-foot space by using the 2-inch lens. The 2-inch lens, at 6 feet from the subject, has a horizontal field of 1.13 feet. At 12 feet, the distance at which we are now working, the lens has a horizontal field of 2.26 feet, or about 2 feet 3 inches, which is sufficient for our shot.

We have now learned that by retaining the same camera distance and changing the lens to one of a different focal length, we can get either a larger or smaller image of the subject being photographed.

We have seen the effect of using a lens of longer focal length when we did not wish to change the camera position. There is sometimes an advantage gained in not changing the camera position. This is true where we must keep the same camera angle so as not to gain a different view, no matter how slight the difference is. That is, we may take several shots of different size from the same camera position. If we do this, we should focus all lenses to be used on the point being photographed, before we actually begin the shooting. Thus is it necessary only to change the lenses, thereby eliminating the loss of time needed for the focusing of each lens causing an interruption of the shooting. If the camera in use is one which is equipped with a turret, and three lenses can be mounted on it at the same time, it is a simple matter to switch from one lens to the other, by simply turning the turret until the lens desired is in position.

TELEPHOTO LENS

Despite what has been said above about the desirability of retaining the camera position, we sometimes may want to get closer to a subject, but find that we cannot due to some intervening obstacle. That obstacle may be a high picket fence, a stream of water, or a ravine too deep to cross. Nevertheless, on the other side of that obstacle there is something we wish to get a picture of.

In viewing the subject visually, we find that it is so far away, that we cannot see it large enough to distinguish details, so we make use of a pair of binoculars or a telescope. By using this instrument, we have increased the power of the eye by the power of the telescope.

If we are using a 4-power telescope, we have increased the power of the eye by 4X. This will bring the subject four times

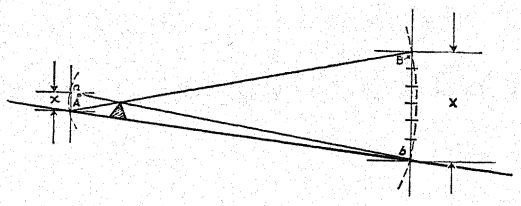


FIG. 9. When the short end of a lever is moved the distance *a-A*, the long end will move through six times that space or *B-b*. The same will happen when a telephoto lens moves

nearer, thereby enabling us to distinguish detail. By the same token, if the subject is so far away that the 1-inch lens will not distinguish detail, we can increase the power of the camera by using a 4 or 6-inch lens. These lenses will increase, respectively, the size of the image by 4X or 6X.

Precautions. In using the telephoto lens, there are certain precautions to be observed. Using the lever as an illustration, we know from our elementary physics that if we have the point of balance or fulcrum closer to one end than to the other, that on depressing the shorter end, the longer end will move in what seems to be a greatly disproportionate arc (Fig. 9). It can readily be seen that we need move the shorter end only slightly to cause a considerably greater displacement of the longer end. When binoculars of fairly high power have been used, you have probably been disconcerted by the difficulty of holding them on a certain point—that by moving the glasses slightly, the object could be entirely displaced from the field of view. The seemingly great movement of the subject was apparently all out of proportion to the very slight movement of the glasses.

This analogy can be applied similarly to the telephoto lens. As a lens of 4-inch focal length will magnify objects 4X, so it will magnify any movement of the camera in the same proportion. Hence, if we use this lens on a distant object and the camera is moved slightly to one side, that movement, when the picture is projected, will be magnified four times. It can thus be concluded that, when using a telephoto lens, any movement of the camera will be magnified by the number of times magnification of the lens. It might be said here that the average user of a camera cannot hold a camera equipped with a lens of greater focal length than 3 inches steadily enough to get pictures without blurring.

There is one obvious way of eliminating this movement and that is by supporting the camera on a solid base. The easiest way to do this is by use of a tripod. The tripod cannot be too strongly advised when telephoto lenses are in use. Tripods should be sturdily built and equipped with a tilting and panorama head. In use, the necessity will become obvious.

Telephoto Focusing. By referring to Table I, you can determine when it is essential to use the focusing mount of the telephoto lens (Fig. 10). If the subject is further away than the greatest value given in this table for a specific lens, merely set the lens at infinity and make the picture. If you wish to include some subject in the foreground and you are using the 3-inch lens, assuming that the



FIG. 10. Kodak Anastigmat f/1.6 50mm long-focus lens for Cine-Kodaks and Cine-Kodak Eights. With a depth of field indicator, two-phase focusing, and a focusing line from which the distance scale (infinity to 2 feet) is calibrated. The threaded front accepts accessories without an adapter ring. By consulting the depth-of-field scale just below the right milled edge, it is seen that the depth will extend only from infinity to some 500 feet at f/1.6, as set. At an aperture of f/22, everything from 15 feet to infinity would be in focus

light permits the use of stop *f*/8, we find that by the formula given on page 2299, the near sharp limit is about 17 feet and the far sharp limit is about 29 feet, thereby preventing us from taking the distant shot as well as the near object at the same time. However, we can still make this shot if we employ the hyperfocal distance, and, referring to Table I, we find that with the 3-inch lens focused on the hyperfocal distance (which is 94 feet) and our subject in the foreground at about 23 feet from the camera, the subject can be brought to within 17 feet of the camera, that being the near sharp limit, and the far sharp limit is 2191, or infinity. The last figures are found by using the formula on page 2299.

From this, we can realize the importance of the simple formula and the charts, as well as the ability to use them, in connection with making movies which will be the kind your friends will not become bored with seeing.

CLOSE-UP WORK

The telephoto lens has another property which can be put to use for the very interesting business of making pictures of small objects at a close distance. This is a very fascinating departure from regular photography, as some of the results are amazing if not startling.



FIG. 11. For close-up work, extension tubes may be used (see *Extension Tubes For Cine Cameras* article). Here the Goerz Reflex Focuser serves as a lens extension tube 1.38 inches long and also as a focusing device. Photo from Bell & Howell

For example, a 4-inch lens covers a field of only 4⅞-inch wide when the camera is 4 feet from the subject. If we were to photograph an insect such as a butterfly in this manner, it would fill the entire screen. This is so because in a field of not quite 5 inches, the butterfly, if it happens to be one of fairly good size, will almost fill the field of view, hence it will fill the screen in the same proportion. The writer has done a considerable amount of this type of work, both still and movie, and the results quite compensate for the effort put into it. Try to imagine a full blown red rose, photographed in Kodachrome filling up the entire screen. It is difficult to describe the effect it has on the audience. By employing these properties and characteristics of lenses, you mark yourself as one who can produce other than the usual run of home movies, and you will never lack an audience.

Focusing for Close Work. When doing the above type of work, measurements should be made from the subject to the film plane (Fig. 11). Also bear in mind that the depth of field is much shallower than when the camera is used at a greater distance. In making these close-ups, the diaphragm must be opened a little wider than for normal shooting in the same light.

SUPPLEMENTARY LENSES AND EXTENSION TUBES

For the movie maker who does not own a camera which provides for quick change of lenses, there is a line of supplementary lenses available. These lenses are for the photographer who owns a cine camera with one lens of normal focal length. By attaching this piece of equipment by means of a screw- or slip-on mount to the normal lens, the camera may be used for close-up or wide-angle work.

For close-up work with any Ciné-Kodak with a 25mm *f*/1.9 lens, for instance, there are two supplementary lenses available in W-mounts. These slip inside the front of the lens barrel, taking the place of the usual lens shade. Supplementary Lens No. 1 makes work at 9½ inches possible and the

No. 2 covers the range from 11⅞ to 23⅞ inches.

The wide-angle attachment is a valuable accessory also. This supplement is a simple affair, increasing the effective field of view by 50 per cent. The apparent field of view may be judged merely by looking through the wide-angle attachment itself and actually seeing the additional area. One line of these wide-angle supplementary attachments is the Hyper-Cinor of Bell & Howell, which fits the 1-inch *f*/2.7 Taylor-Hobson cine lens.

Cine lenses may also be adapted for close-up work by the use of extension tubes. These tubes normally make possible an addition to the focal length of from ½ to 7½ inches. For more on these, see article on *Extension Tubes For Cine Lenses.*

USES FOR SPECIFIC 16mm LENSES

3-Inch Lens. As we have already discussed some of the features and possibilities of the 2-inch lens, we will continue with the 3-inch lens. As this lens has a magnifying power of 3X, it can be used advantageously at sporting events where one is confined to the grandstand. Horse races, football and baseball games, etc. will be better photographed with this lens than with the 2- or 1-inch lens.

4-Inch Lens. Nothing greater than 4 inches is generally recommended for use by the average amateur. This lens has a remarkable depth of field and can be used in photographing wild life, close-ups, where it is not advisable to change the camera position, mountain photography, etc. It represents about the ultimate length which can be satisfactorily hand-held, and you would be well advised to use a tripod with it wherever possible.

6-Inch Lens. As the 6-inch lens is quite a specialized piece of equipment, the user should be thoroughly acquainted with all its possibilities before using it for serious or important work. For use in the field where the photographing of timid birds or other wild life is the objective, there is nothing better than this lens. It has a magnifying power 6 times that of the 1-inch lens, and its narrow field of view can be judged from the comparison of Field of View chart on page 2303. *Always use this lens with a tripod, as any camera movement will be magnified six times and, on viewing the picture, this movement will spoil an otherwise good film.*

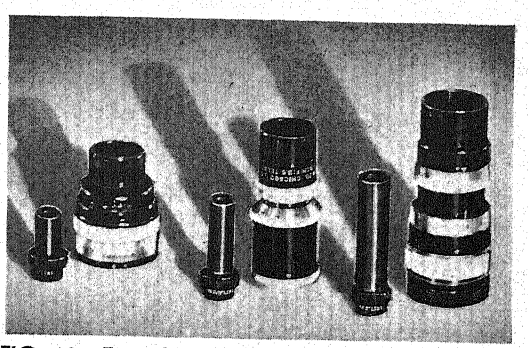


FIG. 12. Extra lenses for the Bell & Howell Filmo Turret 8mm camera. From left to right they are the 1-inch, 1-1/2-, and 2-inch lens. With view finder objectives for each

15mm Lens. This lens is generally accepted to be the standard focal length for a wide-angle lens when using a 16mm camera. It is especially useful when space does not permit the operator to move back from the subject a sufficient distance to use the 1-inch lens. It will be found invaluable when shooting on small boats, narrow streets, and indoors where the rooms are inclined to be small. It includes almost twice the field of the 1-inch lens, and has a great depth of field. For outdoor shots, with the exception of close-ups, it can be set at infinity almost all the time, and then used as a U.F. lens. *When using the wide-angle, be sure the camera is absolutely level, as any deviation will create distortion.*

LENSES FOR 8mm CAMERAS

12½mm Lens. This is the standard "normal" lens for the 8mm camera, and although it is of a focal length that is half of that of the standard 16mm camera lens, it nevertheless includes on the 8mm camera the same field as that of the 1-inch lens on the 16mm camera. It is *not* a wide-angle lens, but one of normal field of view. Its depth of field is great, permitting the user to use it at full aperture as close as 5 or 6 feet without too much loss of definition. This focal length lens is supplied rated at speeds of *f*/2.5, *f*/2.7, and *f*/3.5. They are all Universal Focus lenses, and can be used in conjunction with Table I appearing on page 2297.

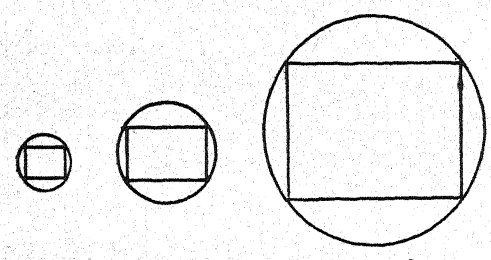


FIG. 13. The covering power of a lens is governed by the light it projects towards the film. These circles of light are compared for 8, 16, and 35mm cameras

1-Inch Lens. This lens is the same as far as focal length is concerned as that used with the 16mm camera, except that on an 8 it performs as a medium telephoto lens (Fig. 12). Because of its focal length being twice that of the standard, it follows that this lens has a magnifying power of two times, hence a correspondingly smaller field of view. It gives an image four times the size on a field one quarter the area of that recorded by the standard lens. This type of lens is ideal on the 8mm camera, as it can be used when some (but not extreme) magnification is desired. These lenses are obtainable with maximum ratings of *f*/2.7, 2.5, 1.4, and other variations of the standard scale of *f*-stops. It is possible on some cameras to have a standard 1-inch lens so modified that it can be used with the 8mm camera.

This is true of many lenses of different focal lengths. Some manufacturers have even supplied special adapter mounts so that these various lenses can be used interchangeably on 8mm or 16mm cameras. It is best to have a reliable dealer advise you on this, as he is supplied with the necessary data, which show the adaptability of lenses, and which lenses will lend themselves best to this adaptation.

1½-Inch Lens. This lens can be used for the same purpose as the 3-inch lens on the 16mm camera. It has a magnifying power of 3X and is a good lens to use at sporting events where the playing field is not close enough to get a good size image with the standard or the 1-inch lens. The lens is generally rated at *f*/3.5.

2-Inch Lens. Here we have the equivalent of the 4-inch lens on a 16mm. The same precautions mentioned in connection with the use of the 6-inch lens should be applied here as well. It is a 4-power telescope applied to your 8mm camera and will produce an image 16X as large as the image produced by the standard lens. This 16X image will be in a field one quarter as wide and one quarter as high as that of the 12½mm lens.

LENSES FOR 35mm CAMERAS

A few words about standard or 35mm cameras would not be amiss at this time. This size film is used in all the production studios and is considered the standard for motion pictures. Although the 16mm film is the standard amateur size, it is often referred to as a "sub-standard" size.

The normal lens for a 35mm camera is a lens of 2-inch length. The reason for this is that the film used in the standard camera is four times as large in area as that which is used in the amateur camera. Hence we must have lens of greater covering power than that afforded by the 1-inch lens.

It does not follow, however, that the 2-inch lens of the 16mm camera will be suitable for the 35mm camera. The covering power of a lens is determined by the circle of light it projects toward the film. This circle of light is always a slight bit larger than the greatest dimension of the film it has to cover (Fig. 13). The 2-inch lens for a 35mm camera will give the same relative size image as a 1-inch lens on a 16mm camera or the same as that of a 12½mm lens on the 8. In other words, if we have three cameras, one an 8, the next a 16, and the third a 35, each equipped with its normal lens, these three cameras will produce the same relative size image, providing they are set up at the proper distances from the subject (Fig. 14).

Notwithstanding the foregoing, some users of 16mm cameras have had lenses which were designed for use with the 35mm camera, altered with certain adaptations for use on the 16mm camera. This can be done, but by and large it is safe to say that the expense does not always justify this action. It is sometimes done in extreme instances where an operator wishes to get a certain result which he feels cannot be gotten by using the lenses designed for the camera he has. Another reason may be that he has

LENSES FOR AMATEUR MOVIES

CINE LENSES FOR 16mm AND 8mm CAMERAS

Name	*Type*	*Focal Length*	*Speed*	*U.F. or Focusing*	*Angle of View at Infinity*	
					Hor.	*Vert.*
BELL AND HOWELL 8mm						
B & H Anpax	Norm.	½″	2.5	U.F.	*See Table III*	
THC	Norm.	½″	2.5	U.F		
B & H Anate	Norm.	½″	3.5	U.F.		
T-H	Norm.	½″	1.4	F.M.		
THC	Med. Tele.	1″	2.7	U.F.		
THC	Med. Tele.	1″	2.7	F.M.		
THC	Med. Tele.	1½″	3.5	F.M.		
B & H Telate	Med. Tele.	1½″	3.5	F.M.		
THC	Med. Tele.	1″	1.5	F.M.		
B & H Extol	Med. Tele.	1″	1.5	F.M.		
THC	Telephoto	2″	3.5	F.M.		
Telate	Telephoto	2″	3.5	F.M.		
BELL AND HOWELL 16mm						
T-H	Wide Angle	15mm	2.5	U.F.	*See Table III*	
T-H	Wide Angle	15mm	2.5	F.M.		
T-H	Norm.	1″	2.7	F.M.		
B & H Ansix	Norm.	1″	2.7	F.M.		
B & H Lummax	Norm.	1″	1.9	F.M.		
B & H Extol	Norm.	1″	1.5	F.M.		
T-H	Norm.	1″	1.5	F.M.		
T-H	Med. Tele.	2″	3.5	F.M.		
B & H Telate	Med. Tele.	2″	3.5	F.M.		
T-H	Med. Tele.	3″	4.0	F.M.		

CINE LENSES FOR 16mm AND 8mm CAMERAS (*Continued*)

Name	*Type*	*Focal Length*	*Speed*	*U.F. or Focusing*	*Angle of View at Infinity*	
					Hor.	*Vert.*
BELL AND HOWELL 16mm—Continued						
B & H Telate	Med. Tele.	3″	4.0	F.M.	*See Table III*	
T-H	Telephoto	4″	4.5	F.M.		
B & H Telate	Telephoto	4″	4.5	F.M.		
T-H	Extreme Tele.	6″	5.5	F.M.		
T-H	Extreme Tele.	6″	4.5	F.M.		
B & H Telate	Extreme Tele.	6″	4.5	F.M.		
EASTMAN KODAK 8mm						
Kodak	Wide Angle	9mm	2.7	U.F.	26° 6′	19° 48′
Generally No Individual Trade Name for Eastman Cine Lenses	Norm.	½″	1.9	F.M.	19° 24′	14° 36′
	Norm.	½″	2.7	U.F.	18° 42′	14° 6′
	Norm.	½″	3.5	U.F.	19° 42′	14° 54′
	Med. Tele.	1″	1.9	F.M.	9° 54′	7° 24′
	Telephoto	1½″	4.5	F.M.	6° 36′	5°
	Telephoto	1½″	2.5	F.M.	6° 36′	5°
	Telephoto	2″	3.5	F.M.	5°	3° 42′
	Telephoto	2″	1.6	F.M.	4° 54′	3° 42′
	Telephoto	2½″	2.7	F.M.	4°	3°
	Extreme Tele.	3″	4.5	F.M.	3° 18′	2° 30′
EASTMAN KODAK 16mm						
	Wide Angle	15mm	2.7	F.M.	34°	25° 42′
	Normal Fixed Focus	20mm	3.5	U.F.	26° 30′	20°
	Norm.	1″	1.9	F.M.	21° 30′	16° 12′

LENSES FOR AMATEUR MOVIES

CINE LENSES FOR 16mm AND 8mm CAMERAS (*Continued*)

Name	*Type*	*Focal Length*	*Speed*	*U.F. or Focusing*	*Angle of View at Infinity*	
					Hor.	*Vert.*
EASTMAN KODAK 16mm—Continued						
	Med. Tele.	2″	3.5	F.M.	10° 54′	8° 6′
	Med. Tele.	2½″	2.7	F.M.	10° 48′	8° 42′
	Med. Tele.	3″	4.5	F.M.	7° 12′	6° 30′
	Telephoto	4″	2.7	F.M.	5° 24′	4° 6′
	Telephoto	4½″	4.5	F.M.	4° 48′	3° 26′
	Extreme Tele.	6″	4.5	F.M.	3° 36′	2° 42′

Note: The above Eastman Kodak 16mm lenses can be adapted to use on 8mm cameras by the employment of an adapter which is supplied by the manufacturer.

WOLLENSAK 8mm						
Cine Velostigmat	Norm.	½″	1.9	F.M.	19° 42′	14° 48′
Cine Telephoto	Med. Tele.	1″	2.7	F.M.	9° 54′	7° 24′
Cine Telephoto	Telephoto	1½″	3.5	F.M.	6° 36′	5°

WOLLENSAK 16mm						
Velostigmat	Wide Angle	15mm	2.7	U.F.	36° 6′	27° 6′
Cine Velostig.	Wide Angle	15mm	2.7	F.M.	36° 6′	27° 6′
Cine Velostig.	Norm.	1″	1.5	F.M.	21° 2′	16° 9′
Cine Tele.	Med. Tele.	2″	3.5	F.M.	11° 4′	8° 1′
Cine Velostig.	Med. Tele.	2″	1.5	F.M.	11° 4′	8° 1′
Cine Tele.	Med. Tele.	3″	4.0	F.M.	7° 2′	5° 2′
Cine Tele.	Telephoto	4″	4.5	F.M.	5° 3′	4° 5′
Cine Tele.	Extreme Tele.	6″	4.5	F.M.	3° 4′	2° 4′

Note: The above Wollensak 16mm lenses can be adapted to use on the 8mm cameras by the employment of an adapter supplied by the manufacturer.

Editor's Note: The angles of views in this table are given in degree units and minutes. There are 60 minutes to a degree. The above listed lenses are not all available due to conditions arising from shortages of materials. However, there is on the market a good supply of cine lenses and it would be advisable for the reader who contemplates the purchase of a lens to visit several dealers before making a definite decision. By diligent search, almost any cine lens is available.

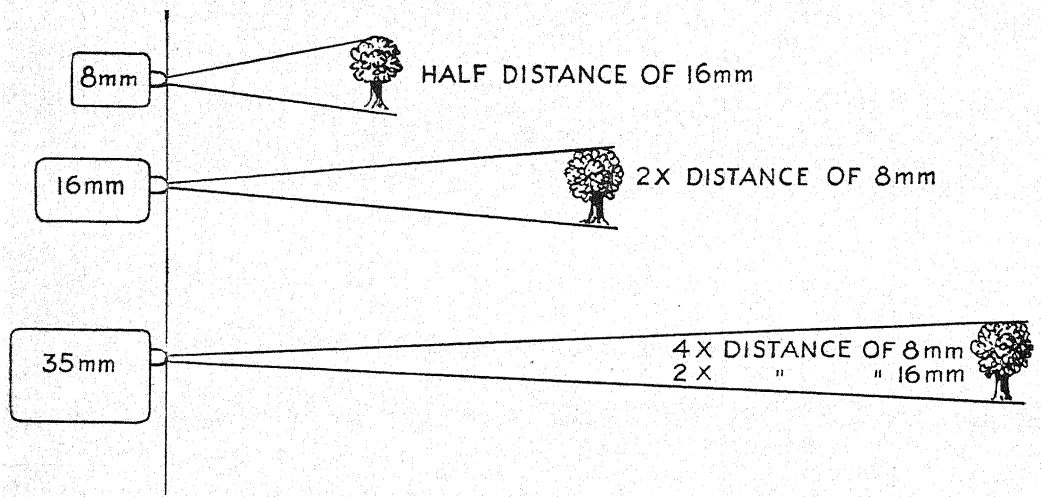


FIG. 14. If an 8, 16, and 35mm camera, each having its own normal lens, are set up as shown, the relative image sizes will be the same

come into possession of a fine 2-inch lens for 35mm and, instead of disposing of it, may decide to have it fitted to his 16mm camera. There is no particular advantage gained here except the additional focal length.

SUMMARY

In summarizing, we should come to the following conclusions:

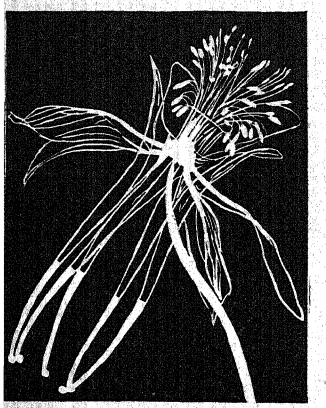
1. *Color Correction:* Generally, anastigmatic lenses of good and better quality can be assumed to be color corrected. That is, they allow, within certain limitations, all the colors of which white light is composed to come to focus at one plane, giving us an all-over sharp picture.

2. *Diaphragm:* All lenses have a diaphragm which allows us to control the amount of light which enters and passes through the lens, thereby giving us one factor in exposure. This diaphragm also is a controlling factor in focus.

3. *Hyperfocal Distance:* All lenses, regardless of make, focal length, or speed, have definite hyperfocal points dependent upon the stop used.

4. *Depth of Field:* All lenses have a certain depth of field, and this depth of field depends on two factors: point focused on, and stop used. Within this depth of field, all objects will be in focus.

(Continued on page following insert)



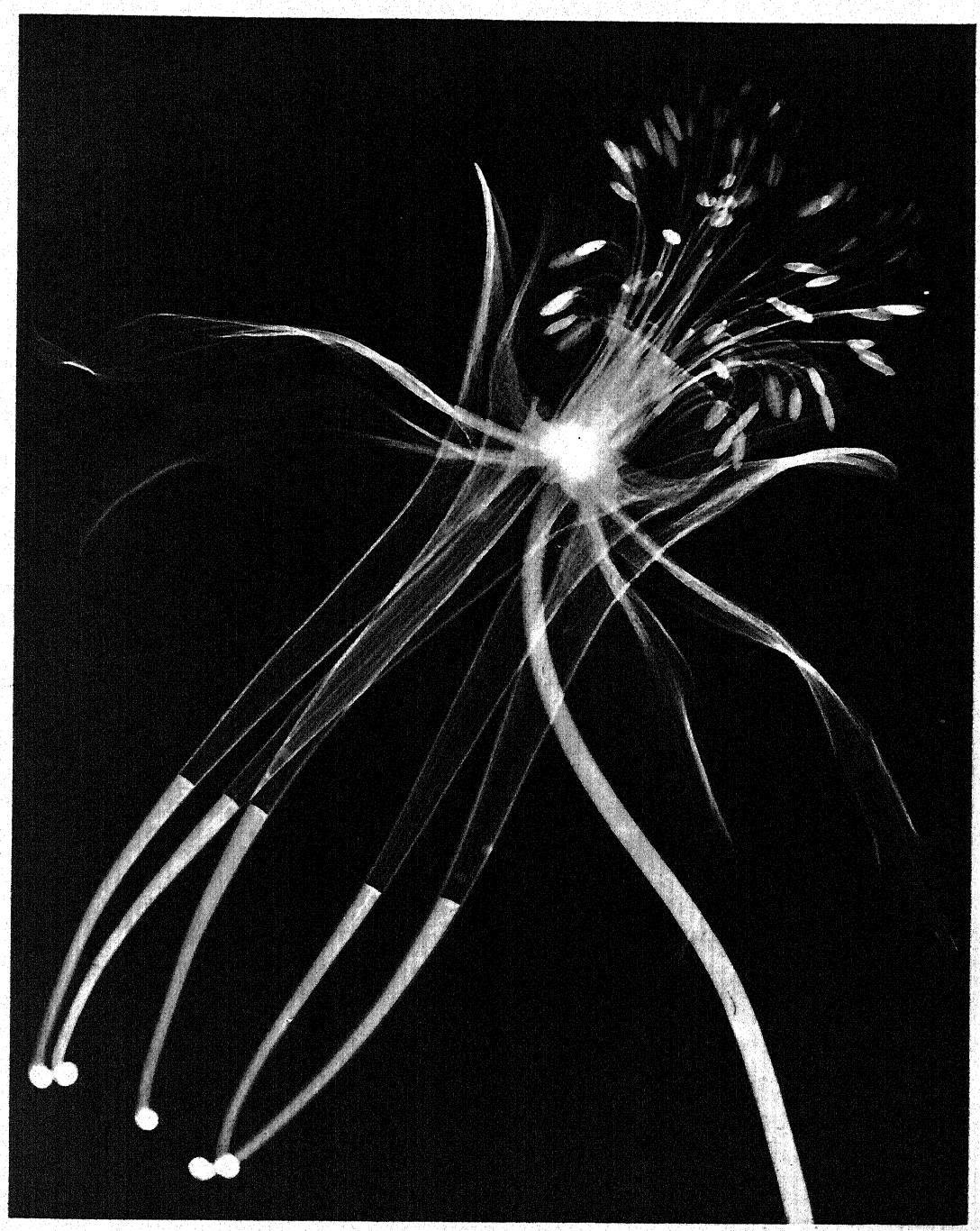
COMPOSITION ANALYSIS for . . . COLUMBINE

What appears to be a cross between a fountain, trumpet tubes, a chalice, and a fireworks exhibition is actually a marvelous phantom of a columbine blossom X-rayed. Where the plant tissue was opaque it withheld the exposing rays and preserved dense white. Less opaque tissues passed enough vibrations to render a diaphanous quality. Extremely thin petal sections gave almost no obstruction to the bombardment of X-rays and are therefore spookily missing. Most beautiful are the linear and contour overplays where the structural shapes and fiber details are seen through one another.

It is curious how abstract this design becomes when it is reversed in black and white and when all surface texture of the familiar flower is out of the picture. Now the structural energy and poetry of the nature form is seen in these musical lines. Revealed as lines of naked force, the flower form seems as alive in its gesture as a humming bird or dragon fly or some transparent radiolaria. Thickening of the tissues at the structural tips and centers, which is necessary in the life economy of the plant, is also amazingly right as pure design. The fine precision of the veining detail adds to the unearthly effect.

Anyone lucky enough to have X-ray equipment has a rich field to explore.

Barbara Morgan



COLUMBINE **H. F. SHERWOOD**

Grenz radiograph of a columbine blossom. See *Radiography* story



DOUBLE PORTRAIT — **LOTTE JACOBI**

In portraiture few things are more difficult than the double portrait. This one of Mr. and Mrs. M. H. Williams is well composed and beautifully lighted. Both are looking at the same object and this action unites them. On the other hand, they are separated by the profile effect of the lighter woman's face on the darker man's head



CHINESE SISTERS — **LOTTE JACOBI**

The contrast of plain background and simple lighting with the elaborate design of the Chinese costumes is well planned in this double portrait. It is often hard to do justice to both subjects because the best lighting and pose for one may not be right for the other. These sisters, arranged almost in one plane, share the picture area well



CHEYENNE MOUNTAIN SCHOOL

LAURA GILPIN

This outdoor scene of a class in dancing is interesting particularly for its backlighting, bringing the foreground dancers and musicians into prominence

(*Continued from page preceding insert*)

5. *Focusing:* a. Universal lenses need not be focused but the hyperfocal point can be changed by changing the stop.

b. Focusing mount lenses are equipped with a focusing ring permitting the user to change the point of focus within the limitations of the particular lens.

c. Focusing mount lenses also have a hyperfocal point depending upon the stop used.

6. *Shutter Speeds:* a. Different cameras have different shutter speeds, and upon these speeds depends the exposure or stop which must be used to obtain correctly exposed films.

b. The stop used is in direct proportion to the speed of the shutter, and these two factors in most cases should be considered as variables.

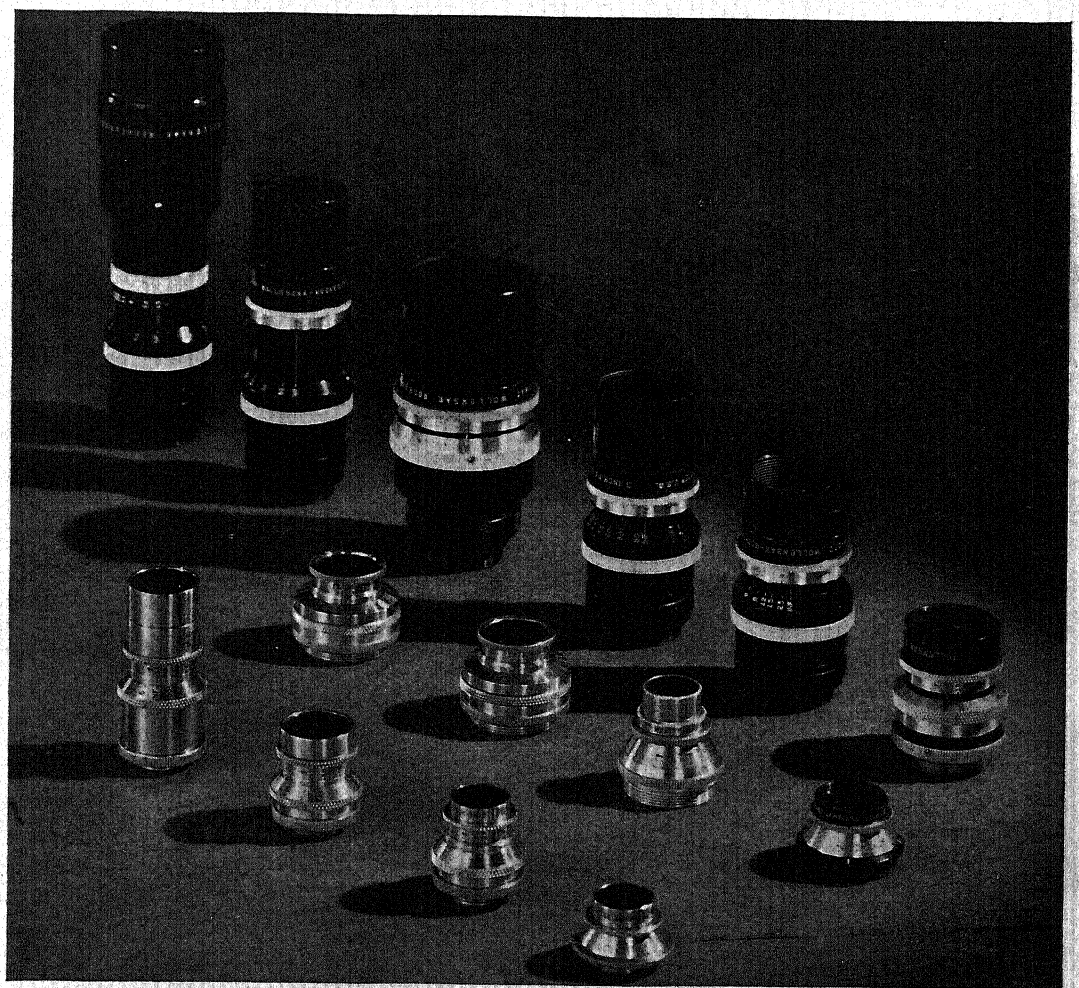
7. *Focal Length:* a. All lenses have a definite focal length.

b. Upon the focal length depends the magnifying power of the lens.

c. The field of view is also dependent upon the focal length.

d. The longer the focal length, the greater the magnifying power and the larger image size produced.

8. *Field of View:* The shorter the focal length, the greater the field of view.



Wollensak Cine lenses. Back row, left to right: 6-inch f/4.5 telephoto; 4-inch f/4.5 telephoto; 2-inch f/1.5 telephoto; 3-inch f/4 telephoto; 2-inch f/3.5 telephoto; 1-inch f/1.5 Velostigmat. Center, left to right: 1-inch f/2.7 Velostigmat; 17mm f/2.7 wide-angle; 1-inch f/2.7 Velostigmat fixed focus; 17mm f/2.7 wide-angle fixed focus. Front row, left to right: 1½-inch f/3.5 telephoto for 8mm; 1-inch f/2.7 telephoto for 8mm; ½-inch f/1.9 Velostigmat for 8mm; 13mm f/2.5 Velostigmat fixed focus for 8mm

NEW DEVELOPMENTS

The motion picture industry has seen almost miraculous changes in equipment from the time the cine lens was a simple two or three element piece of equipment until now.

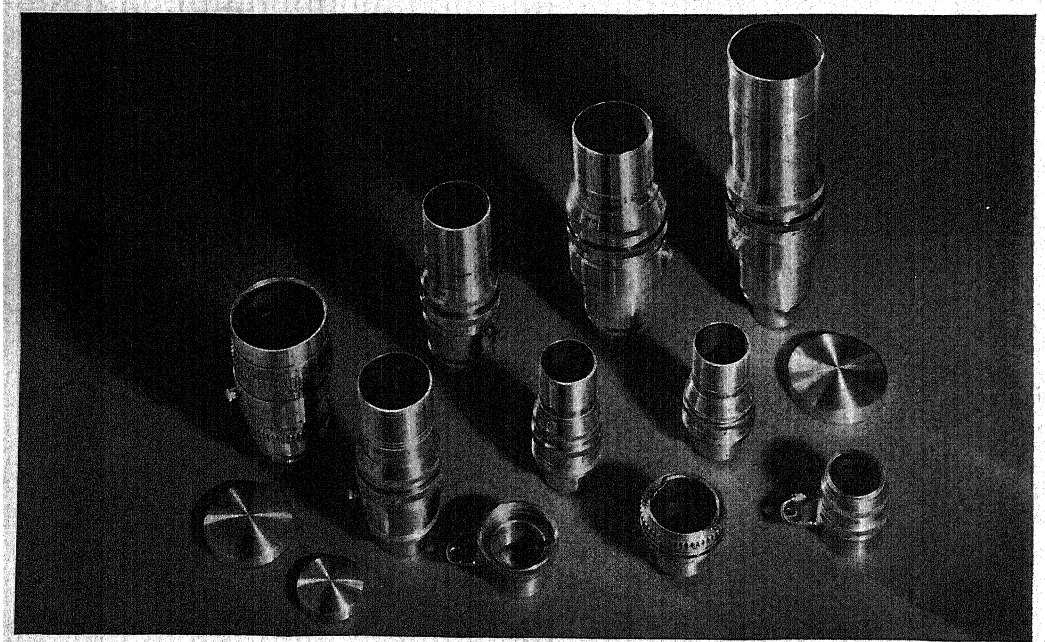
Oscillating Lens. The latest development is a lens which has one of its elements independently suspended so that it can be caused to vibrate 13,200 times a minute. This vibration takes place within a space of three tenths of a millimeter, and the "shivering" is caused by the use of an electronic circuit.

The effect of this shivering is to bring all objects within certain planes in focus, this never having been accomplished before. For example, the range being selective, the controls can be set to have all objects in focus from 4 to 8 feet or 8 feet to infinity, while all other planes are out of focus. This does result in a slightly softer focus of all subjects, but does not effect the focus to the point where it would be disturbing. Even though there is a change in the relative position of one of the elements, there is no change in image size (see article on the *Electroplane Camera*).

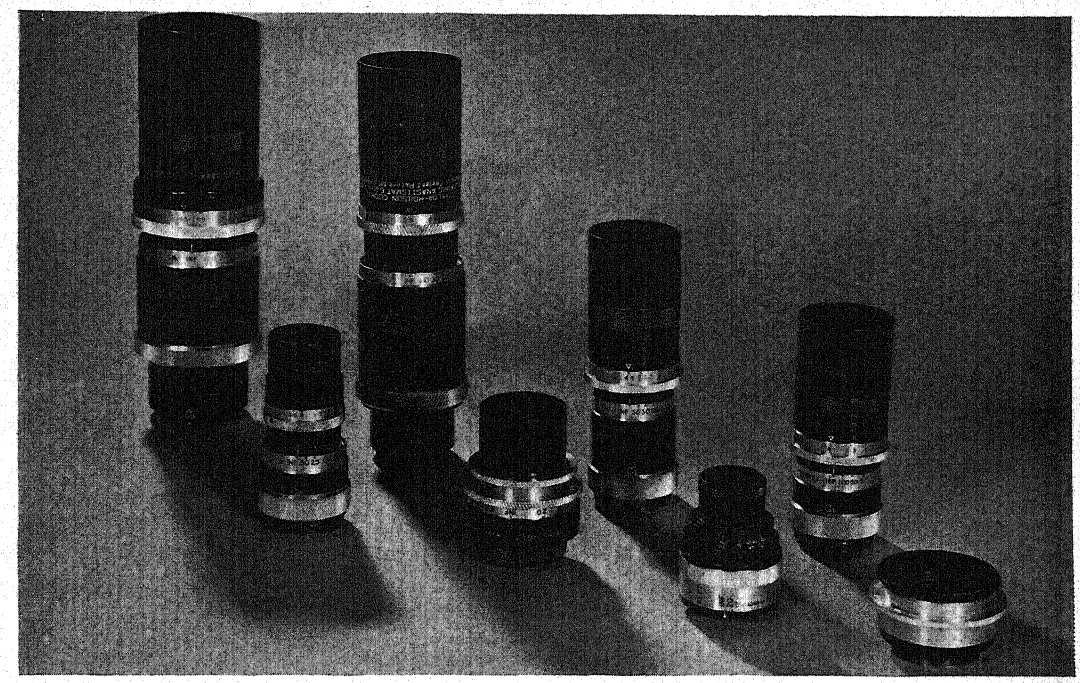
High Speed Tele. Another important development is the high speed cine telephoto lens. To you who have used motion picture cameras for a comparatively short time, the *f*/3.5 telephoto lens is a normal piece of equipment, and some even consider it "slow." But not so long ago, the fastest tele lens that could be had was about *f*/6.3. This lack of speed sometimes caused great inconvenience in the taking of movies. Where the light was insufficient, one of two things had to be done: either use artificial light such as flares or magnesium wire, or else large incandescent or arc lights or the idea of taking a picture under the conditions had to be given up.

Now, due to the ability of the lens to pass a great amount of light in a given period of time, and the fact that film is many times more sensitive to light than before, it is possible to get good pictures under very adverse lighting conditions.

Zoom Lens. A lens that was variable in its focal length was developed for use in the studios by Bell and Howell. It accomplished the "zoom" shots that are so effective and possessed of great dramatic value. It can be used from one camera position and can follow a subject from one point to another. If the camera should be set up in one corner of a room and it is desired to follow an actor as



Cine-Kodak lenses. In front row are, from left to right: lens adapter for Magazine Cine-Kodak, focusing 15mm f/2.7 wide-angle lens, and 25mm f/1.9 lens. Center from left to right are: 114mm f/4.5 lens, 50mm f/3.5, and 76mm f/4.5. The back row has, left to right: 50mm f/1.6 lens, 63mm f/2.7, 152mm f/4.5, and 102mm f/2.7. The metal discs are lens covers



Filmo 16mm Taylor-Hobson cine lenses. From left to right: 6-inch f/4.5; 2-inch f/3.5; 6-inch f/5.5; 1-inch f/1.5; 4-inch f/4.5; 1-inch f/2.7 in focusing mount for Filmo Auto Load; 3-inch f/4; 15mm f/2.5 in focusing mount

he walks in through a door, across the room, and sits at a desk, by a predetermined setting, the operator need only follow him in the finder, and turn a crank which changes the focal length of the lens so as to accommodate the changing distance to the actor.

Ultra Speed. It might be of interest to tell here about a lens which once made an appearance on the market, rated at the tremendous speed of *f*/0.99. This was a 1-inch lens in focusing mount with a great aperture. It was designed for the Filmo Camera and could be used where the light was of very low intensity. It had a definite disadvantage, however, and that was its extremely shallow depth of field, due to the large aperture. If it were being used at full aperture, *f*/0.99, and a person was focused upon at about 5 feet, both the front plane and the rear plane of his figure could not be brought to sharp focus. If the nose were focused on, the ears would be out of focus. Its only practical use at full aperture was at infinity, and it did fill a definite purpose that way.

CONCLUSION

All in all, the manufacturers today have reached such a high point of scientific efficiency in the matter of optics that it is generally best to abide by their findings and suggestions. Realize that they have at their command the men, the time, the money, and, above all, the necessity for experimenting with new ideas, so that they can improve their products. When they have determined certain factors and have made this data available to us it would be well to follow the advice and instructions given if we wish to get the best results out of our equipment, and make picture taking a real pleasure and diversion.

LENSES WITH SURFACE COATING

Richard S. Morse

President, National Research Corporation, Boston

One of the most modern phases of lens manufacture is lens coating—a process which reduces the lens-air surface reflections. The author, who heads a pioneer company in the field, tells about the scientific aspects of lens coating—discussing the chemical etching, layer films, and evaporated films methods.

See Also Lenses And Their Characteristics

THE REFLECTION of light from glass surfaces can, under some conditions, become a serious problem, particularly in the case of complex optical systems. Because of both

single and multiple reflections, a very real reduction in light transmission and sharpness of image may result. Under adverse lighting conditions, so-called "lens flare" may become a particularly serious difficulty (see page 2318).

In the case of normal incidence, the following expression can be derived for the ratio of the amplitude of the reflected to the incident beam at one glass-air surface:

$$\frac{I}{I_0} = \left\{\frac{n-1}{n+1}\right\}^2$$

where n = refractive index of the glass
I = amplitude of reflected beam
I_0 = amplitude of incident beam

In the case of a single glass surface, where n equals 1.50, approximately 4 per cent of the light which falls upon it normally is reflected and a single component has a transmission of approximately $(.92)^2$ or 96 per cent, depending on its refractive index. This effect as a function of the number of surfaces can be seen by reference to Table 1.

TABLE 1

NO. OF LENS COMPONENTS	OVER-ALL TRANSMISSION*		
	Uncoated	*Coated*	*Relative Increase*
1	92.0%	99%	7.6%
2	84.5	98	16.0
3	78.0	97	24.3
4	71.6	96	35.5
5	66.0	95	44.0
6	60.5	94	55.5
7	55.7	93	67.0
8	51.3	92	79.5
9	47.2	91	93.0
10	45.7	90	100.0
20	21.6	81	279.0

*The transmission values for coated and uncoated lenses are representative values such as may be expected under optimum conditions for optical glass components treated by the high vacuum evaporation technic—measurements being made with white light.

If a glass surface such as a lens is coated with a transparent film,* it can be shown that the normal reflected beam from the coated surface is formed by two rays, one reflected from the air-film boundary (A) and the other from the film-glass boundary (B). These two rays form a resultant ray of intensity:

$$I_r = A^2 + B^2 + 2AB\cos\left\{2\pi\frac{D}{\lambda}\right\}$$

where: A = intensity of the ray from the air-film boundary
B = intensity of the ray from the film-glass boundary
D = difference in the optical paths traveled by the A and B rays
λ = wave length of light
I_r = resultant ray intensity

From the above fundamental equation it can be shown that for monochromatic light the resultant reflected intensity I_r can theoretically be made to equal zero providing that the following two fundamental conditions are fulfilled:

a) $n_1 = \sqrt{n_g n_0}$

where: n_1 = refractive index of the film
n_g = refractive index of the glass
n_0 = refractive index of the air [$n_0 = 1.000+$]

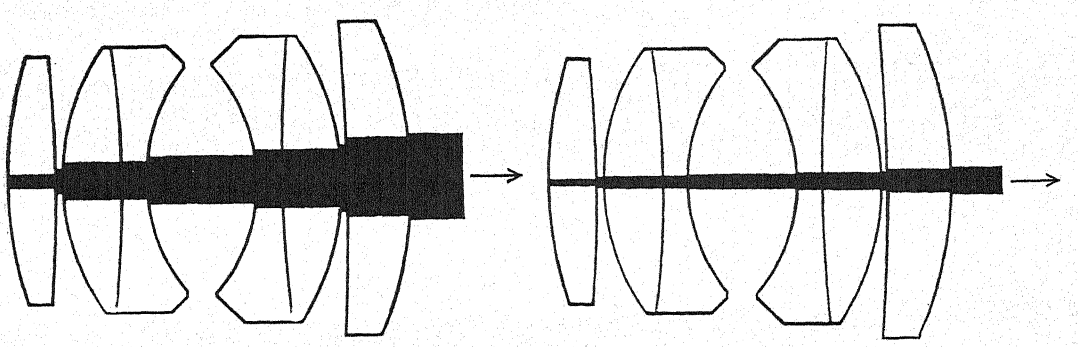
b) $t = .25\lambda\frac{2a+1}{n_1}$

where: t = thickness of the film
a = 0, 1, 2, 3, ... etc.

From a practical point of view certain limitations prevent the achievement of these idealized conditions. Three different processes have been demonstrated, however, whereby surface reflections may be very effectively reduced. Although the above equations have been derived for *monochromatic* light and for *normally* reflected light, it so happens that fairly wide deviations from these two conditions may be made without seriously altering the results attained.

In addition to the increase in transmission which is obtained as a result of low reflection films, the resulting improvement in contrast and shadow detail is of particular importance.[1] Although relative improvements of this type depend upon the number of components in the system, a marked change in picture quality can be noticed, even with the simpler types of photographic lenses employing three components. "Flare spots,"

*The word "film" in this article does not apply to regular photographic sensitive film, but to the lens coating.



BAUSCH & LOMB CINEPHOR. The diagram shows the amount of light which is lost at the glass-air surface of an uncoated lens (left) and the effect of lens coating as seen in the Cinephor lens (right)

which generally result from taking pictures under adverse light conditions, as in the case of photographs taken at night or against the sun, are materially reduced. Contrary to popular opinion, it is the improvement in image quality as a result of the reduction in flare, with attendant increase in contrast at low levels of illumination, which is usually of greater importance in producing fine photographs than the actual increase of over-all light transmission.

CHEMICAL ETCHING METHOD

As early as 1892 Taylor[2] discovered that badly tarnished lenses had the faculty of transmitting more light than new ones, and he demonstrated that this effect could be obtained by subjecting lenses to certain chemical solutions such as ammonium hydroxide, etc. Additional workers[3] have subsequently investigated this technic, and although difficulties are encountered with certain types of glass, hard and durable films can be obtained by controlled etching with appropriate solutions, such as dilute nitric acid. It has also been reported that films may be hardened after etching by a special high temperature treatment.

Generally it has proved much more difficult to treat optical glass surfaces if an appreciable time has elapsed after the grinding and polishing operations. Because such an etching process depends upon the production of a thin film (chiefly some form of silica) through the removal of the other compounds such as metal oxides, one has no choice from the point of view of the refractive index, and therefore optimum reduction of reflection cannot generally be achieved.

SUCCESSIVE LAYER FILMS

The possibility of producing low reflecting surfaces by depositing successive "monomolecular" layers of controlled refractive index has been demonstrated by Katharine B. Blodgett[4], and especially fine results have been achieved from the point of view of very low reflection. This technic consists of building up successive layers consisting of cadmium arachidate and arachidic acid. The arachidic acid is subsequently partially dissolved in alcohol, leaving a film of cadmium arachidate, the final refractive index being determined by the amount of acid removed from the original film. The interstices produced by this process are apparently of molecular size, and consequently there is no appreciable scattering of light, as might be expected.

Unfortunately, films produced in this way are quite delicate, although permanent if not touched or exposed to bright sunlight. This technic may well prove useful as a means of studying interference phenomena in the laboratory, but otherwise such a method is at present of little commercial significance.

VAPOR ETCHING TECHNIC

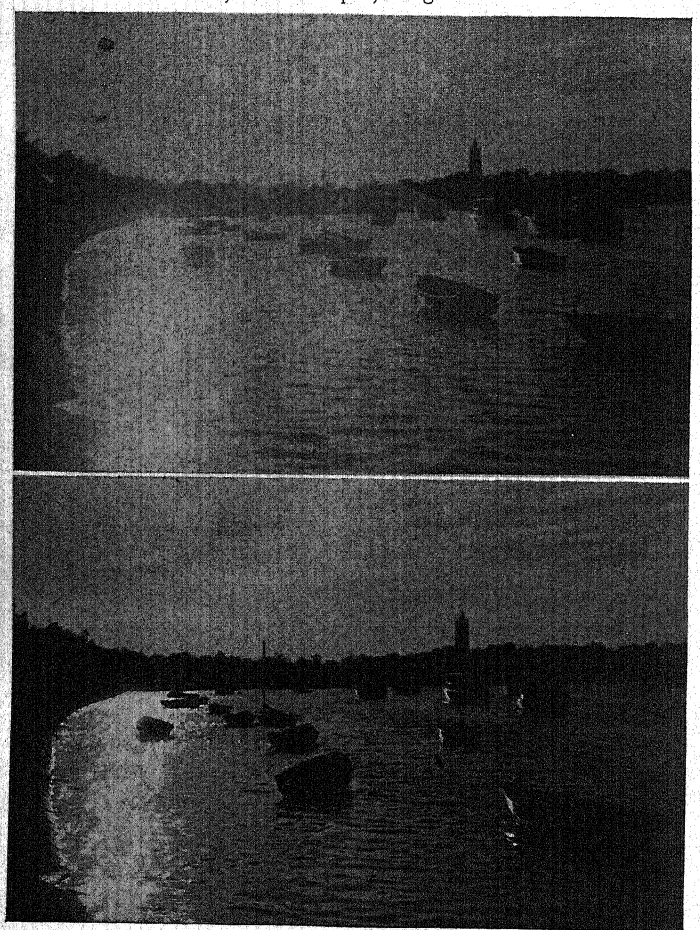
Quite distinct from the method of producing low reflection films by chemical etching, it is possible with certain types of glass to form low reflection films by exposing the surface to hydrofluoric acid vapor.[5] By such a technic, it appears that various oxides in the glass are converted to corresponding fluorides with a resulting reduction in refractive index. As is the case with the chemical etching method, the results obtained are of necessity dependent upon the chemical

composition of the treated material. Generally speaking, optimum results can be achieved only with glass having a high calcium and magnesium content. Such a process does not at present appear applicable to all of the more common optical glasses and particularly lenses which have been in service. Promising results can be achieved with certain types of common window glass. Films produced in this manner are relatively hard and resistant to abrasion.

EVAPORATED FILMS

The possibility of producing thin films of metals and non-metals by a high vacuum evaporation process has been known for some time.[6] It has, for example, long been common practice to form totally and partially reflecting surfaces of aluminum, chromium, silver, etc. in this manner.

Briefly, this technic consists of placing the surface to be treated in a vacuum-tight chamber which is exhausted to a pressure of 10^{-4}mm of mercury or less. The material which is used to form the film is heated electrically to vaporizing temperature by means of a hot filament or "boat" and thus condensed on the surface to be coated. The hardness, as well as the optical characteristics of films formed in this way, vary greatly depending upon the pressure in the chamber during evaporation, and for optimum results extreme care must be exercised in preparing such surfaces before coating. Such questions as the distance between the source of evaporated material and the surface are of particular importance when films of uniform thickness—as in the case of low reflecting films—are required.



EFFECT OF LENS COATING. In the two photographs above, both taken on the same type of film, the results obtained by the use of coated and uncoated lenses are in sharp contrast. Exposures and printing times of both the negative and print were identical, and the lens was a Zeiss Tessar type. At *top*, the effect with an uncoated lens, and *below*, the same scene taken with a coated lens

Generally speaking it is essential that this distance be large as compared with the maximum diameter of the surface to be coated, and special technics must be employed when surfaces of high curvature are encountered. The possibility of producing low reflecting surfaces by high vacuum evaporation has been demonstrated by Strong[7] and Cartwright and Turner.[8]

Although many types of both organic and inorganic materials may be employed to form films in this way, very few meet the requirements of:

a) refractive index
b) hardness
c) water and solvent resistance.

Among the more commonly used materials are MgF_2, CaF_2, NaF, LiF, and Na_3AlF_6. By the deposition

of multiple films of alternately high and low refractive index materials, very interesting color filters, possessing unique transmission characteristics, may also be obtained.

By resorting to heat treating methods and through the use of the best possible vacuum, extremely hard and resistant coated surfaces may be produced. In the case of MgF_2, for example, it is possible to form films that even lend themselves to cleaning with soap and water, or solvents. Ageing tests made under tropical and arctic conditions indicate that there is no problem of film deterioration over long periods of time.

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There are a number of places where lenses may be surface-coated. These include the National Research Corporation, Boston, Massachusetts, Bausch & Lomb, Rochester, New York, Eastman Kodak Company, Rochester, New York, and Vard Mechanical Laboratory, Pasadena, California. It is best to correspond with any particular firm before sending your lens.

LIGHTING

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This is an introduction to and an explanation of the important subject of photographic lighting. Flood lamps, flash lamps, and reflectors, as well as illumination measurement and use of the meter are covered. General advice on lamp and reflector arrangements and uses of auxiliary lighting is given, and with such a broad background, the amateur should feel well acquainted with the field and prepared to go on and perfect his technic.

See Also Artificial Lighting, Interior Lighting For Motion Pictures, Lighting Equipment, Lighting—Fluorescent, Lighting and Studio Technic For Color Ads, Lighting For Movies, Lighting in Multiflash, Lighting in Portraiture, Lighting Sources For Color

LIGHTING is of paramount importance in any kind of photography, but is distinguished in artificial light work because of the control which is possible. Outdoors, the only variables at the disposition of the photographer are the time of day at which he takes his picture and the position of his camera with relation to his subject. In some cases, of course, he can use large reflecting surfaces to advantage, but he is usually limited by considerations of size and convenience. Indoors, on the other hand, the illumination can be entirely controlled by the photographer. He can obtain any reasonable general level, can provide highlighting, backlighting, and separate background lights, and can bring about almost any particular artistic effect which occurs to him. As is the case with a painter, he has light and shadow completely at his disposal. The limit of excellence and scope of his chiaroscuro is his own ability and imagination.

With the advent of panchromatic and full-color films of considerable speed there has been increasing interest among amateur photographers in picture making by artificial light. Extremely simple equipment is adequate to place successful lighting within easy reach of the amateur.

FLOOD LAMPS

Because illumination well above customary room level is necessary for most films, even with the fastest lenses available, special lamps known as "flood lamps"* have been

*The term "flood lamp" in this article refers exclusively to the type of lamp which is intentionally overvolted for photographic purposes, as described in this section.

developed expressly for motion picture and still picture work by artificial light. The filaments of these lamps are so designed that they are overloaded at normal line voltage. In consequence they burn at a much higher luminous efficiency than do filaments designed for ordinary purposes, and the light output of a flood lamp is usually two to three times that produced by a regular lamp of the same wattage. Such an increase is possible only at the expense of lamp life, and most photographic flood lamps have a relatively short life.

Color Temperature. In photography with color film, quality of illumination is of paramount importance because the film is color-balanced to give proper results only with a definite kind of light. By "quality" is meant the color or combination of colors present in the light. This characteristic of a light source is best described in terms of its so-called "color temperature."

The color temperature of a given radiating source is defined as the temperature at which a certain ideal radiator would produce light of exactly the quality of the given source. Most ordinary flood lamps have color temperatures in the neighborhood of 3400° K. Here "K" refers to the Kelvin scale of temperature, which employs ordinary Centigrade degrees but has its zero at –273° Centigrade, the point known as "absolute zero." For special purposes, lamps are made to produce light of particular color temperatures; in this category are the 3200° K lamps made especially for use with certain types of color film. Such regulated color temperatures are obtained by careful filament design. Far greater regulation is possible by means of filters. For example, so-called "daylight" lamps have blue glass bulbs which filter the light in such a way that its temperature is raised to above 5000° K, not far from the color temperature.

Illumination. Illumination provided by flood lamps is most conveniently measured by means of a photometer reading directly in light-intensity units—that is, foot candles.* Dependence of illumination on the direction from which the lamp is viewed is, in general, negligible for inside-frosted lamps, provided, of course, that the directions considered are such that there is no shading effect due to the lamp base.

If measurements are made at intervals throughout the life of a flood lamp, a steady decrease in illumination is found as the lamp becomes blackened. At the time when the lamp burns out, the illumination has dropped to roughly three-quarters of its original value. A decrease of this amount appears to be general over the total life period of all flood and projection* lamps, regardless of wattage, life, color temperature, or any other factors.

Conditions under which flood lamps are used determine in large measure their performance characteristics. In general a lamp is given a voltage rating by its manufacturer and all other ratings apply only when the lamp is operated at its rated voltage. Light output, life, and color temperature are dependent in varying degrees upon the applied voltage. For example, if a lamp rated at 115 volts is operated at 120 volts, its light output is increased about 16%, while its life drops 40%. Its color temperature may be raised some 45°. Despite such variations, flood lamps designed for operation at 115 volts are considered satisfactory over the range from 105 to 120 volts. Film latitudes normally obscure the effect of changed light output from the lamps due to reasonably small voltage variations.

Flood lamps are available in a number of sizes. Ordinarily there is a choice between 250-watt lamps with a life rating of some three to five hours, and 500-watt lamps, giving twice as much light, with a life rating of six to ten hours. Both these types fit in standard household sockets, and they are popular with amateur photographers on that account. Larger lamps, of 1000 watts and 2000 watts, are available, with life ratings of ten to fifteen and fifteen to twenty hours respectively, but they are equipped with "mogul" bases, which require special large sockets.

*The foot candle is defined as the illumination produced when the light from a standard candle falls normally on a surface at a distance of one foot. Numerically it is equivalent to the lumen per square foot, or—in other words—it expresses the flux or flow of light (in lumens) incident on a unit area.

*Projection lamps are used in projectors and also in spotlights. They are characterized by a concentrated filament structure.

FLASH LAMPS

Frequently it is necessary or desirable to employ a light source of extremely high intensity, above the maximum readily obtainable with flood lamps. Flash lamps are designed to meet such conditions in the still-picture field. Enclosing a quantity of foil or wire of a substance such as aluminum, these lamps have, in addition, a short filament which becomes incandescent when voltage is applied to the lamp. Ignited by the filament, the foil or wire burns with extreme rapidity, giving a flash of exceedingly high intensity and short duration. Flash lamps find a wide field of use, particularly in cases where a small diaphragm stop or a high shutter speed must be used, or where it is not convenient to set up and adjust flood lamps, or where the light source must be very far from the subject photographed (see articles on *Flash*).

Characteristics of flash lamps, such as peak intensity, color, and duration of flash, are dependent on the nature and amount of material enclosed in the bulb. By proper design a lamp can be made with an exceptionally short, high-intensity flash, or with a longer flash of lower maximum intensity. The primary requisite of flash photography is synchronism of the flash with the actuation of the camera shutter. If a mechanical or electrical synchronizer is used, it must be precise in its operation so as to render exposures predictable and reproducible. Long-flash lamps are designed especially for use with cameras having focal plane shutters which sweep across the film and require uniform illumination throughout the period of sweep.

A method of flash photography which is easy for the amateur to use is the open flash technic. With the camera set on "Time" or "Bulb," the shutter is opened, the lamp flashed, and the shutter immediately closed. The entire flash is utilized and there is no question of synchronizer operation. Short-flash, high-intensity lamps are suitable, giving exposures which may be as short as 1/200 second. This method has one marked disadvantage which does not arise when a synchronizer is employed: if the subject is in motion, there must be little enough light from sources other than the flash lamp so that no discernible image is formed on the film before and after the lamp has been flashed. However, inasmuch as the shutter need not be open for more than one second at the most, this condition is not difficult to fulfill in a dimly lit room or outdoors at night or in subdued daylight.

As in the case of flood lamps, the color of flash lamp illumination is of great importance with color film. Again the quality of light is to some extent governable by factors within the lamp itself, but a high color temperature, approaching that of daylight, is attainable only through proper filtering. One type of flash lamp has a blue lacquered glass bulb which filters the flash to a quality closely approximating daylight. Such lamps are of use with color film if there is a mixture of daylight and artificial light, making daylight-balanced film necessary. This point will be discussed further. Flash lamps of the ordinary type are, in general, close enough to flood lamps in color temperature so that color film balanced for one gives entirely satisfactory results with the other.

REFLECTORS

Pictures made by bare flood or flash lamps are in most cases not entirely satisfactory. Shadows are too sharp and the lighting, in consequence, is rather harsh and unflattering. Furthermore it is difficult to prevent the lamps from shining directly into the camera lens. Reflectors are designed to increase the efficiency of photographic lamps by reflecting to the subject some of the light which would otherwise be wasted. Thus the photographer needs fewer lamps for the same illumination, or he can use his lamps farther from the subject. Moreover, reflectors provide somewhat diffuse shadows because they broaden the source of light so that each part of the source helps to illuminate the shadows cast by other parts. Such diffuse shadows are usually more pleasing than the sharp shadows formed by bare lamps.

Important characteristics of a reflector are its efficiency and the angular distribution of the light reflected from it. Distribution can be investigated by means of a photometer, and a chart can be made showing the efficiency corresponding to different directions. The customary reference direction for such measurements is the axis of the reflector—

that is, the line through the lamp filament and the geometrical center of the reflector. For example, if the combination of lamp and reflector is pointed directly at the photometer, the axial illumination is measured; then the axial efficiency is the ratio of this figure to the illumination given by the lamp alone at the same distance. If the lamp and reflector are turned around an axis through the filament and perpendicular to the reflector axis, the illumination can be measured at any angular position, and compared to its axial value.

Distribution Curve and Useful Angle. Figure 1 shows distribution curves for two particular reflectors, one having a highly specular or mirror-like aluminum surface, the other a diffusely reflecting white cardboard surface (Fig. 2). The axial efficiency of the aluminum reflector is seen to be very high compared to that of the cardboard reflector, but it drops far more rapidly as the angle from the axis increases in either direction. Clearly, the aluminum reflector has a much more restricted useful angle than the cardboard, because for large angles its efficiency becomes so small compared to its axial value that the light is no longer of adequate intensity. A subject properly illuminated by the central part of the beam from this reflector would be underexposed in any regions so far from the center that they were illuminated only by light from large reflector angles. On the other hand, more exposure is required with the cardboard reflector at the same distance because of its lower central illumination, but it can be used to cover a wider angle because its light is far more uniform in intensity.

For each type of reflector, then, a useful cone of light is determined from the distribution curve. A safe criterion for most purposes is that the cone shall be limited to an angular extent such that the minimum illumination shall be at least half the maximum. In the light of this precept it is seen that the total useful angle of the aluminum reflector in Figure 1 is nearly 20 degrees in each direction from the axis, or a total of about 40 degrees. The cardboard reflector has a much larger useful angle and, for such a reflector, measurements are usually based on a 60-degree spread of light, because such an angle is fully adequate for most purposes.

Reflectors having a narrow useful angle are frequently quite suitable for amateur motion pictures but entirely inadequate for most work with still cameras. The reason for this is that motion picture lenses in general cover a considerably smaller angle than do still camera lenses. For example, a 1-inch focal length lens for 16mm work takes in a maximum angle of about 13° each way from its optical axis, whereas a general purpose still picture lens normally covers an angle about twice as large. Usually the illumination on a scene must cover an area at least as great as that which will appear in the final picture. It is obvious that in order to cover a given area, a narrow-angle reflector must be farther from the subject than a wide-angle reflector. This situation is illustrated in Figure 3, which shows the variation of field width with distance from subject for two reflectors and for two lenses. Any horizontal line on this

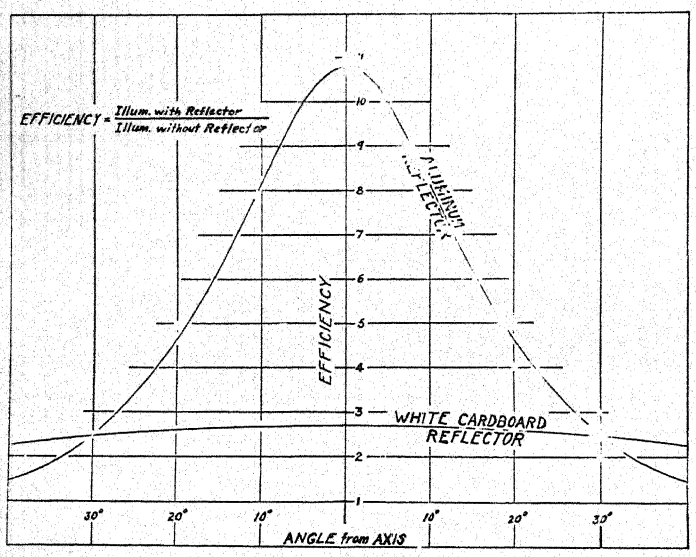


FIG. 1. Light distribution curves for an aluminum reflector and a white cardboard reflector. The former has a more restricted useful angle than the cardboard, but within that angle it is far more efficient

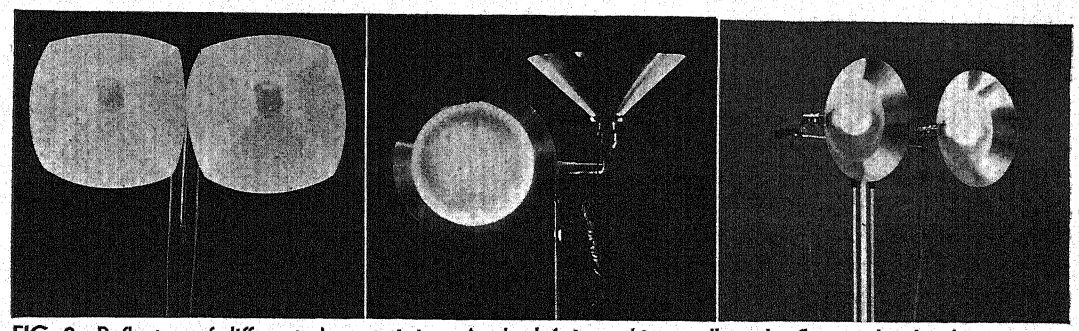


FIG. 2. Reflectors of different characteristics. At the left is a white cardboard reflector, the distribution curve of which is shown in Figure 1. Its angle is very large and its efficiency (ratio of illumination with reflector and without) is about 2¾. Center is a specular aluminum reflector whose distribution curve is shown in Figure 1. Its useful angle is 40° and its efficiency about 8. At the right is an aluminum reflector with sandblasted center. The total useful angle is 60° and the efficiency is about 3½

graph represents a certain width of field, and its intersections with the lens and reflector lines give the distances at which such a field is covered. Clearly, if aluminum reflectors of the 40-degree type illustrated were used with the average still picture lens, the camera would in all cases have to be ahead of the reflectors. This is a serious restriction which is obviated if reflectors of the wider-angle type are used. For this reason, reflectors having angles of 60 degrees or greater are nearly always employed for still work. On the other hand, Figure 3 shows that a 1-inch lens on a 16mm camera can be at about one and one-half times the reflector distance with the 40-degree reflector illustrated, and therefore such highly efficient narrow-angle reflectors are suitable for most motion picture work.

Color. For color photography the question of reflector color is important. Color film, balanced carefully for certain particular light sources, requires that any reflector shall not materially change the color of the light it reflects. For this reason reflectors are nearly always white or of a bright metal such as aluminum, because such reflecting surfaces introduce no noticeable color change.

ILLUMINATION MEASUREMENT

From curves like those of Figure 1, with actual illumination plotted instead of efficiency, average illumination at a given distance for a given lamp-reflector combination can be determined. The average is taken over whatever angular spread the curve indicates to be appropriate for the lamp-reflector combination in question. Now if the average illumination is determined for several distances in this way, the illumination-versus-distance curve can be plotted. Figure 3 shows this curve for a 250-watt flood lamp in a certain type of white cardboard reflector. Each value of the illumination has been averaged over 30 degrees each way from the reflector axis. The curve is plotted on logarithmic coordinate paper; if the source of light were a point instead of a lamp in a relatively broad reflector, the curve would be a straight line demonstrating the inverse square behavior of light from such a source. Indeed, Figure 3 shows that even for this broad source the line is straight for distances greater than three or four feet. Because of the size of the source, however, the line curves at shorter distances in such a way that the illumination is slightly less than would be

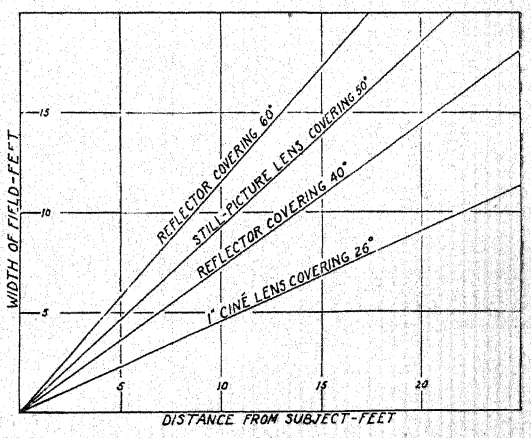


FIG. 3. Variation of field width with distance for various lenses and reflectors. The diagram indicates, for instance, that whereas the 40° reflector is the efficient one to use for the cine lens, it would be inadequate for the 50° still picture lens

predicted by the inverse square law. This is an illustration of the well-known fact that the inverse square law applies only if the distance involved is large compared with the extent of the source of light.

Reflector efficiency varies with the size of the lamp. In general, the efficiency is greater for smaller lamps. For large lamps, some of the light reflected from the center portion of the reflector is blocked from the subject by the lamp bulb itself, and the central efficiency is decreased. A smaller lamp which has less of this shading effect makes more efficient use of the central area of the reflector. The Mazda Nos. 5 and 6 flashlamps are good examples of a midget bulb.

Curves relating illumination to distance, like the one in Figure 4, can be drawn for any lamp-reflector combination. If tests are then made to determine for a given film the illumination required at a certain diaphragm stop and shutter speed, these illumination-distance curves will show at once the proper lamp distances to give that illumination. For other stops and shutter speeds the illumination necessary is easily computed from the basic one determined by test, and again the curves will show the appropriate distances for any number of lamps and reflectors.

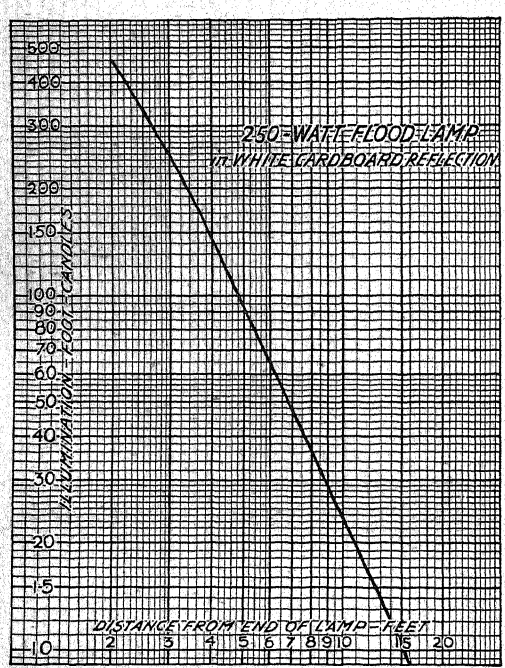


FIG. 4. Illumination-distance relationship for a lamp-reflector combination. Such relations can be drawn for any lamp and reflector

Flash. Flash lamps present quite a different problem from that described for flood lamps. Illumination measurements are extremely difficult because of the nature of the lamps. An ordinary photometer measuring illumination cannot be used; the exceedingly brief flash does not allow a reading to be made because the meter does not respond with sufficient rapidity. However, exposures can be determined by comparison with flood lamp data in the following way. A flash lamp, either bare or in a reflector, is set at a measured distance from the subject. A series of exposures is made at this distance by the open flash method, with different diaphragm stops. Inspection of the results gives the proper stop for the distance used. Now it can be safely assumed that the illumination from this particular lamp or lamp-reflector combination will vary with the distance in exactly the same way as it does with a flood lamp of approximately the same dimensions. By direct comparison with flood lamp data, therefore, proper exposures can be determined for lamp-to-subject distances other than the one actually tested, and for other diaphragm stops.

Flood and flash lamp exposure tables are usually packaged with films, reflectors, lighting units, etc. These tables are made up for different films and different lamp-reflector combinations. Proper distances are given for one, two, three, and four lamps when various diaphragm stops and shutter speeds are used. To make such exposure tables the general method outlined above, or a similar procedure, is often employed. That is, for a given film, the illumination required at a particular stop and shutter speed is found; illumination levels for other exposure conditions are then computed. By means of distribution curves like those of Figure 1 and illumination-distance curves like those of Figure 3, the proper lamp-to-subject distances can then be specified for any number of lamps in any reflectors.

ARRANGEMENT OF LAMPS AND REFLECTORS

Choice of reflector is of first importance. The question of appropriate angular dis-

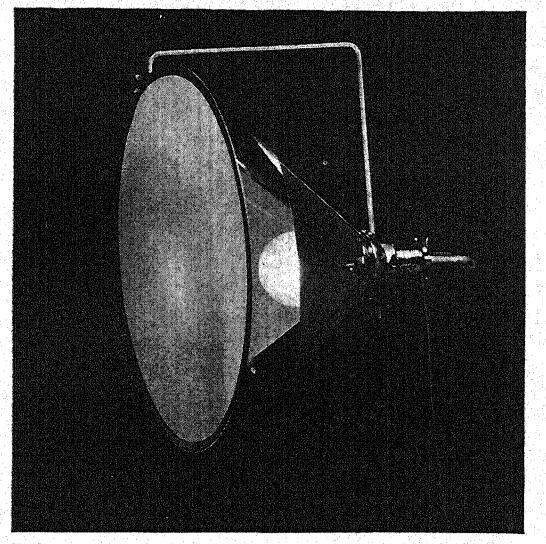


FIG. 5. Specular aluminum reflector with a glass cloth diffuser. Total useful angle is 60°; efficiency is about 2½

tribution of light for motion pictures and for still pictures has been discussed and the fundamental difference must be kept in mind. It can be summarized briefly as follows: the wide-angle type is a reflector of moderate efficiency for general use where high intensity is not important; the narrow-angle type is usually much more efficient, but it is in general strictly limited to motion picture applications. Frequently the field of possible effects can be enlarged by a mixture of the two types of reflectors, one for uniform general illumination, the other for highlighting or other special purposes.

For certain reflectors it is possible to obtain diffusers (Fig. 5) by means of which a narrow beam can be changed to a more uniform spread of light. By this device reflectors such as the aluminum one represented in Figure 1 can serve for all purposes because they can be converted at will into diffuse reflectors having characteristics roughly like those of the cardboard reflector in Figure 1.

With the type of reflector decided upon, there remains the problem of the proper number of lamps and their arrangement with relation to the subject for good exposure at a given diaphragm stop and shutter speed. In flash photography frequently only one lamp is used because illumination from a single lamp is ample for most shots. Flood lamps give less light, and in general several are used at once. Where more than one lamp is specified in exposure tables, it is assumed that the light from all the lamps is superimposed (that is, each lamp and reflector is pointed directly at the subject). If the extent of the subject is such that, for example, half the lamps must be pointed at one part of it and half at another part, then the exposure must be based on only half the total number of lamps, because the illumination on any part of the subject is that given by half the lamps. Relatively large areas to be photographed may constitute a very cogent reason for the use of wide-angle reflectors, even for motion picture work, because the larger a subject is, the more difficult is the problem of uniform lighting.

AUXILIARY LIGHTING

Auxiliary lighting is a device which lends depth and interest to pictures (Fig. 6). It can take many forms and is used in many ways, providing a fertile field for the ingenuity and imagination of the photographer. Exposure tables are used usually

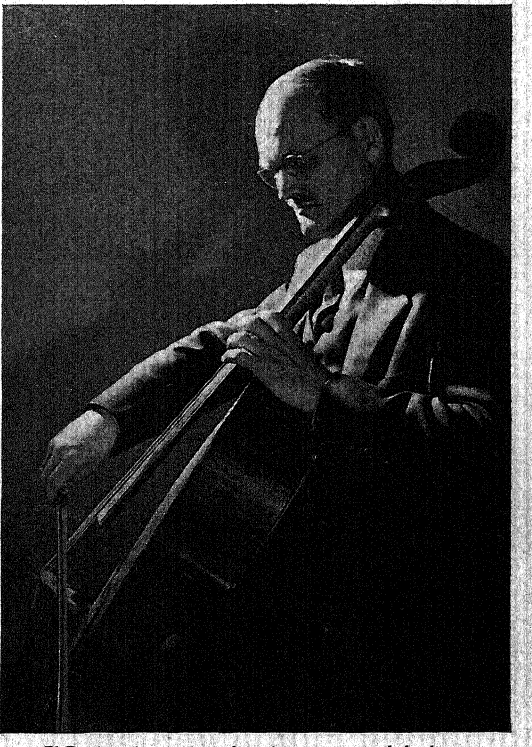


FIG. 6. An example of extreme sidelighting



FIG. 7. Backlighting delineates the subject and provides effective lighting for the hair. The illusion of depth is also somewhat heightened

only as a starting point, giving the basic amount of illumination necessary for good exposure over the whole subject. With this basic level established, auxiliary highlights can be added by means of extra lamps or separate reflectors properly located. If highlighting effects are localized on the subject, there may be little change in the exposure required. This depends upon the particular effect sought. Depth and roundness can be added to portraits and other types of picture by the use of backlighting. A flood lamp in a reflector placed behind the subject and above it or slightly to one side will provide sufficient backlighting to make the subject stand out from the background (Fig. 7). Backlighting in general has no effect on exposure determination. For authentic atmosphere in night pictures at home, an ordinary floor lamp with its bulb turned on can be included in the scene. If the lamp shade is not too translucent, a flood lamp can be substituted for the regular service lamp and used to highlight a face, book, magazine, etc.

BACKGROUND LIGHTING

Separate lighting of subject and background is frequently employed, for it allows regulated exposure of either with respect to the other. Accentuation of the main subject in a picture may be brought about by striking underexposure of its background, or in some cases by the opposite effect, underexposure of the central subject itself. Furthermore, separate lighting is often a necessary device where the same exposure is desired for subject and background (Fig. 8). This is especially true when the distance from main subject to background becomes significant compared with the lamp-to-subject distance, because in this case the inverse square law has a particularly powerful effect. For example, if proper exposure of a subject is obtained with lamps four feet away, and the background of the picture is two additional feet beyond the subject, then the background will be underexposed by more than one full stop unless it is illuminated separately by lamps closer to it. On the other hand, if proper exposure is given by lamps at ten feet from a subject, then a background two feet farther from the lamps will be underexposed by only half a stop.

TYPES OF LIGHTING

No attempt can be made here to exhaust the possibilities in the field of artificial lighting for photography. Countless variations make this impossible. Something can be said, however, regarding the appropriate types of lighting for different films. Much of the interest in the average good photograph

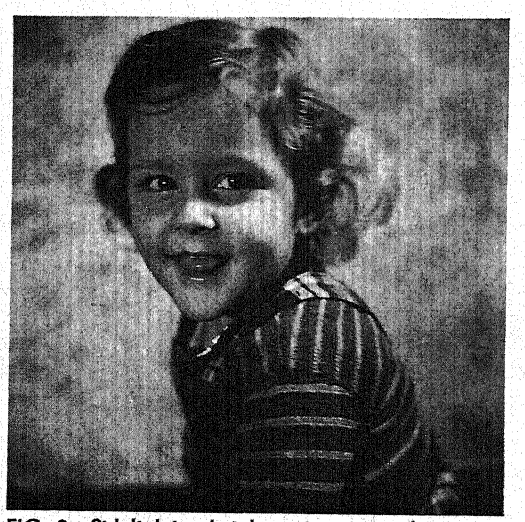


FIG. 8. Sidelighting heightens interest and improves modeling. Subdued sidelighting was achieved here with one lamp near the camera and the other far to one side and relatively high

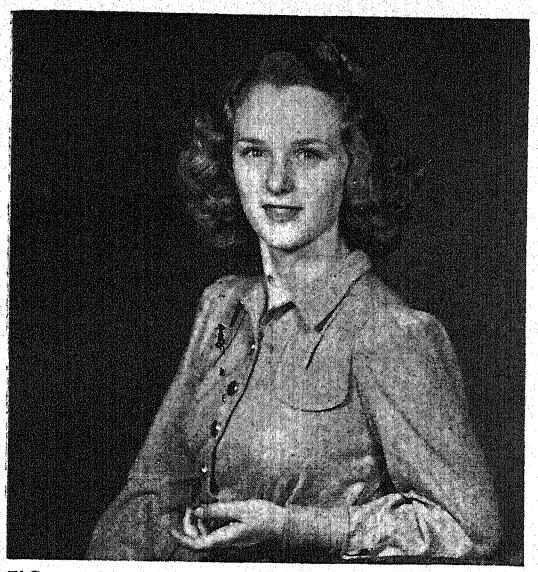


FIG. 9. Here is an example of flat lighting—more appropriate for color than for black and white. One lamp was placed on each side of the camera at 30° and 45° from the camera axis

arises from the nice adjustment of contrast. In the case of a black and white picture, this contrast is contained entirely in a difference of gray tones, and is controlled by means of more or less contrasty illumination. By this is meant illumination which varies in some degree for various parts of the subject. Thus, some parts can be highlighted while others are purposely underexposed to provide the desired gray scale contrast.

Lighting for Color. Photography in natural colors presents quite another question. Color film has relatively little latitude and contrasty illumination which might be entirely suitable for black and white film would give rise to very much overexposed highlights and underexposed shadows if used for color film. In general, lighting for color work should be of the "flat" type, with all parts of the subject uniformly illuminated (Fig. 9). Highlights can be used sparingly for accentuation, but for most purposes contrast in lighting is not needed. Differences in color take the place of differences in gray tones and provide all the contrast interest necessary. Thus, for color photography, tables giving basic flat lighting requirements are very useful, but it should be remembered that deep shadows can well be lightened by means of auxiliary lamps.

Flash Photography. Auxiliary lighting presents some difficulties in flash photography. Naturally if several lamps are used, arrangements must be made to set them off simultaneously. Exact synchronization of all lamps is not necessary when the open flash technic is employed, so long as they all flash within an interval short enough so that no perceptible subject motion occurs to spoil the picture. As for arrangement of the lamps, the same principles apply that have been outlined for flood lamps. The placing of the lamps is best done with the temporary substitution of flood or ordinary lamps in the reflectors for the flash lamps which are to be used in the actual exposure in the same position.

DAYLIGHT AND ARTIFICIAL LIGHT

A special problem frequently encountered is that of illumination by a mixture of daylight and artificial light. This may occur indoors or out, the two conditions being identical with regard to the questions which arise. For black and white photography, the chief problem is usually one of exposure—that is, of the proper balance between the daylight present and the artificial light introduced (Fig. 10). For example, flash lamps used to light dense shadows in outdoor pictures must be so placed that they illuminate the shadows sufficiently for the purpose of the photographer, but do not overexpose them or lighten them so that they appear unnatural. Subjects photographed indoors near a window and illuminated on one side by daylight usually require artificial illumination on the other side.



FIG. 10. An example of the mixing of daylight and artificial light. In color, this scene would need daylight color film and daylight lamps

In cases such as this, ordinary exposure tables can be applied successfully, with the assumption that the shadowed part of the subject is not illuminated at all except by the flood or flash lamps employed.

Mixtures of daylight and artificial light present another problem of prime importance when color film is used. All the illumination falling on the subject to be photographed must be of the color for which the film is balanced. If a picture is made outdoors with film balanced for daylight, any artificial light introduced must be of daylight quality. For pictures indoors in which daylight forms part of the illumination, the same precept applies. If color film balanced for flood or flash light were used, it would be necessary to filter the daylight to that quality. Conceivably this could be accomplished by means of filters over the windows. Obviously a more feasible procedure is to use "daylight" film and do the necessary filtering at the sources of artificial light. Developed for just such purposes, flood and flash lamps of the "daylight" type produce light of such quality that they give excellent results with film balanced for daylight.

USE OF EXPOSURE METER

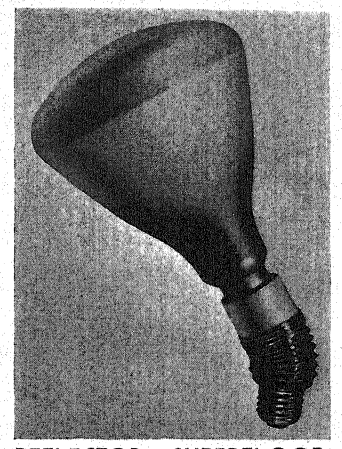
Exposure meter technic is a vast subject which can be mentioned only briefly here (see *Exposure* articles). It is well known that in outdoor use certain precautions must be observed as to the angle of light accepted by the meter. Indoors these precautions become particularly important for several reasons. It has already been pointed out that because of the inverse square law of light, backgrounds indoors are likely to be underexposed. If a meter is allowed to accept light from a relatively dim background as well as from the main subject, the meter reading will be too low and overexposure of the subject will result. The meter should measure only the light from that part of the scene which is of chief interest. Often this is not an easy condition to fulfill, especially with the relatively small subjects and high lighting contrasts which are encountered indoors. With one type of meter some difficulty can be avoided if the light incident on the subject is measured instead of the light reflected from it (see *Incident Light Measurement*). Most photographers evolve a particular technic which they find best suited to themselves; many make a practice of using flesh tones as the basis for all exposure meter readings and others use a gray or neutral card introduced temporarily into the scene.

LIGHTING EQUIPMENT. In almost all phases of photography, the cost of equipment is what you make it, but perhaps in the lighting field is this truest. Lighting equipment may range from the very inexpensive Kodak Handy Reflector with a photoflood bulb to an elaborate overhead spotlight which may cost more than $500.00.

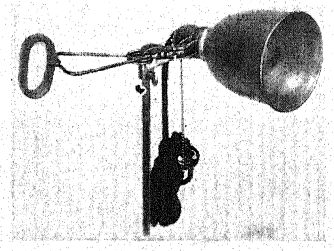
With lighting equipment there are several important things to consider—the first being safety and the second, efficiency. Of course you must first make sure that the equipment will be suited to the current you are using. This is, of course, elementary—and in the case of large installations, if you are not sure, consult an electrician. The efficiency hinges mostly on the material and design of the reflector (see page 2322), and ease of handling will be governed by the flexibility of the tripod or holding arm.

There is much good equipment especially made for photographic lighting and the products of some forty manufacturers give the photographer a wide choice. The following is naturally only a *selective* survey of types of equipment—and it in no way purports to cover the field. For more information, see the articles on *Lighting*, *Interior Lighting*, and *Lighting For Home Movies*. Flash lighting equipment and spotlights are covered in articles entitled *Flash Equipment Survey* and *Lighting With Spots*.

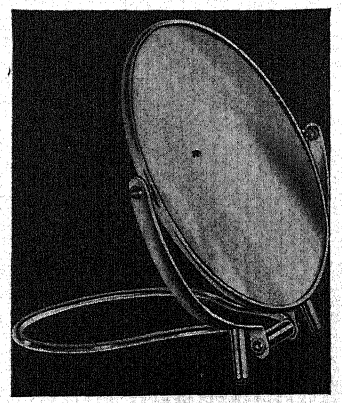
Finally—this bit of advice should be repeated. *Start with simple equipment and master this before going on to expensive and complex equipment.* There are plenty of clamp-on reflectors on the market for a very few dollars and these will be ample for the beginner who is learning lighting. But if you plan to do a good deal with artificial lighting, then look around for something durable, reliable, and with all the conveniences you need. As for homemade equipment, this is hardly worthwhile unless something particularly unusual is needed.



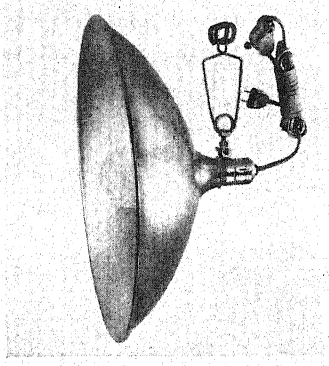
REFLECTOR SUPERFLOOD. With detachable swivel socket. Lamp has its own reflector lining and does not need additional equipment. Concentrates within a 30°-30° zone. Average life is 6 hours at 115 volts. Made by Wabash. With swivel socket, around $1.50



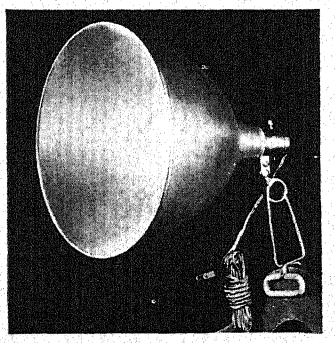
SUN RAY NO. 300 LAMP. Heavy gauge aluminum with etched inside. 4½-inch diameter and 5-inch depth. For No. 1 Photoflood bulb. Around $2.00



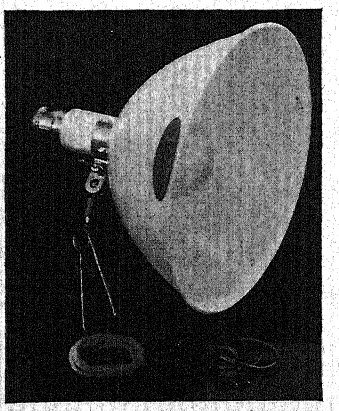
VICTOR NO. 160 SUNFLECTOR. 9-inch convex mirror in aluminum casing. For use with sun or artificial light. Around $5.00



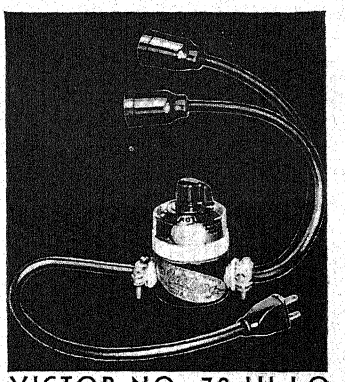
REXO GIANT REFLECTOR. 16-inch reflector, good for the main general illumination of a scene. Etched and scratch-brushed inside surface. Made by Burke & James, Inc. Around $7.00



SIMPLEX NO. 1 REFLECTOR. Oversize construction for even diffused spread of light. Matt reflecting finish. 10½-inch diameter and 8¼ inches deep. For use with No. 1 and No. 2 Photoflood bulbs. Made by Burke & James, Inc. With swivel spring clamp and cord, around $3.50



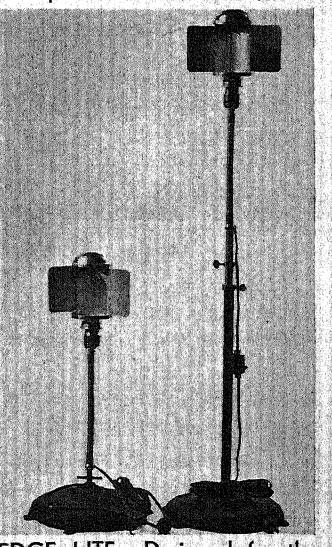
VICTOR 250-S. For No. 2 Photoflood bulbs. 11 inches in diameter; 9 inches deep. White enameled finish. Around $3.00



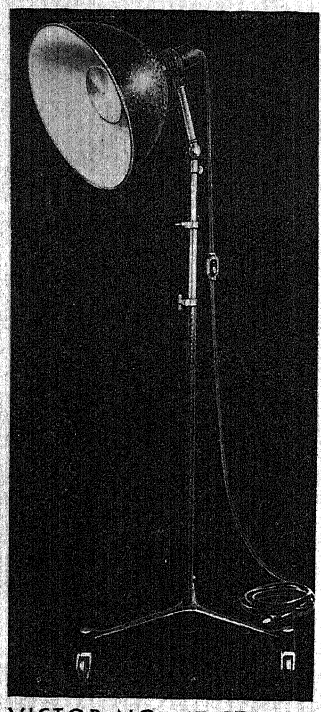
VICTOR NO. 72 HI-LO SWITCH. 10 amps. For No. 2 Photoflood lamps. Has 2 utility leads of 10 inches and one plug. Three positions are off, low (series), and high (parallel). Around $5.00



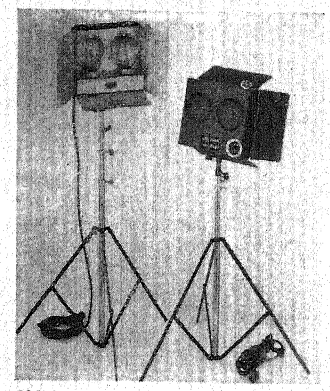
KODAK HANDY REFLECTOR. Model C, made of cardboard and collapsible. Used with standard lamp sockets. Less than $.25



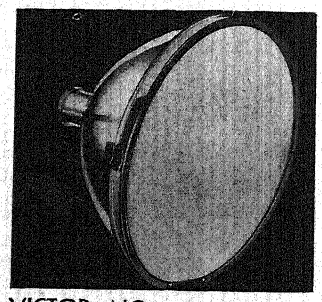
EDGE LITE. Designed for the halo effect, especially in portraiture. May be on the tripod (left) or the 3-section telescopic stand (right). Made by Acme-Lite Co. Price for former is around $8.00; for the latter, around $10.00



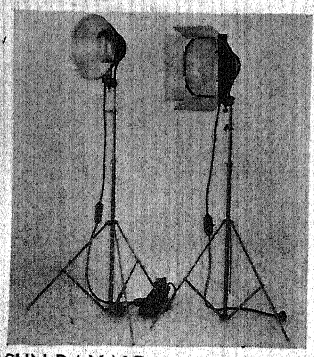
VICTOR NO. 47 STUDIO LIGHT. For No. 4 Photoflood lamps, 500-watt Mazda, 500-watt K 3200° Mazda, and No. 75 Photoflash lamps. Heavy gauge spun aluminum reflector, 16 inches in diameter and 10½ inches deep. Interior is soft oxide. Hood with mogul socket; telescopic studio tripod of steel with casters, adjustable from 3 to 9 feet elevation. Around $23.00



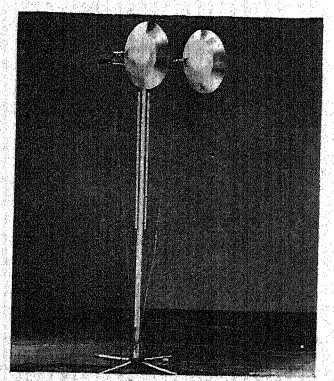
SUN RAY NO. 10 JR. For No. 1 Photofloods or 500-watt T-20 bulbs. Special switch (see back view at right) allows burning of two bulbs dim, two bulbs bright, or one bulb bright. Complete with No. 1 tripod, around $25.00



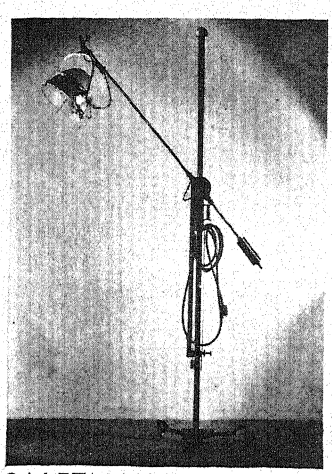
VICTOR NO. 326 MELLO-BEAM DIFFUSING SCREEN. For 12-inch reflectors. Combination of spun glass and lucite. Around $2.00



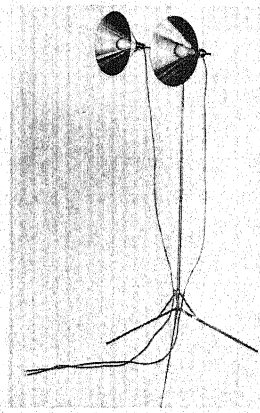
SUN RAY NO. 20 LAMP. Reflector of heavy gauge aluminum, etched inside and with parabolic etched reflector behind the bulb. For use with No. 1 Photofloods, 500-watt projector, or 500-watt tubular bulb. Lamp alone is around $8.00; with tripod it is around $13.00; side shields are around $4.00 extra



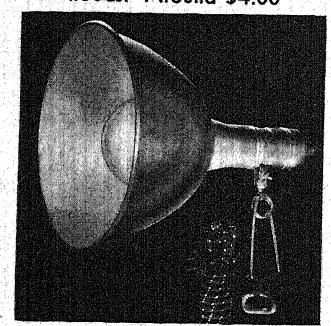
KODAFLECTOR SENIOR. Lighting from floor level to 7½ feet high. Sandblasted at center to give even spread of light. Shaft consists of two 30-inch telescopic steel tubes. Two sockets mounted on rods with adjustable clamps. With 12-foot cord and No. 1 and No. 2 Photoflood adapters, around $12.00



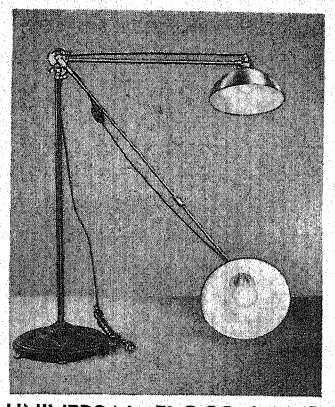
SALTZMAN OVERHEAD FLOODLIGHT. 5000 watts. Counterbalanced stand. Height varies from floor to 13½ feet. G-64 lamp. Around $280.00



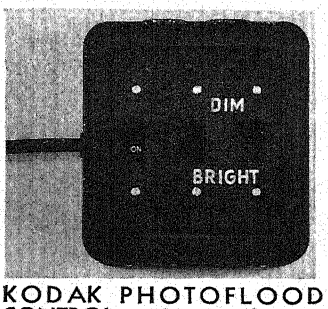
KODAFLECTOR. 6 feet 4 inches fully extended; minimum is 2 feet 10 inches. Each lamp aimed in any direction. For No. 1 Photofloods. Around $4.00



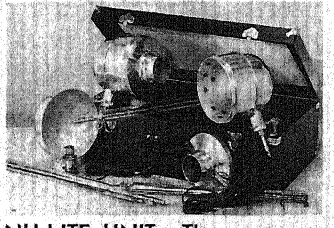
MOGUL SIMPLEX REFLECTOR. 10½-inch clamp-on reflector with mogul socket for use with the No. 4 Photoflood bulb. Parabolic design. Made by Burke & James, Inc. Around $7.00, without bulb



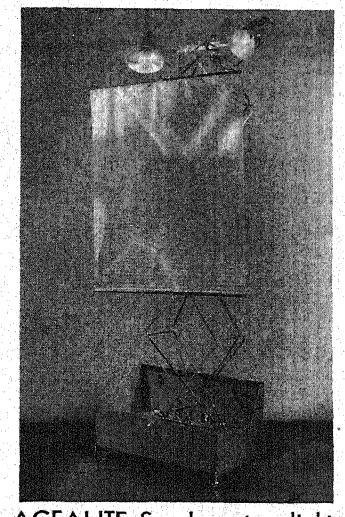
UNIVERSAL FLOOR LAMP. Brass joint at top of stand allows positions in 360° radius, 30-inch extension on each reflector arm, and swivel socket for each lamp. Reflectors hold No. 2 bulbs and are 10 inches in diameter and 5¾ inches deep with etched interior. 12-foot wire with switch-in-line. Made by Acme-Lite Co. As shown, around $13.00



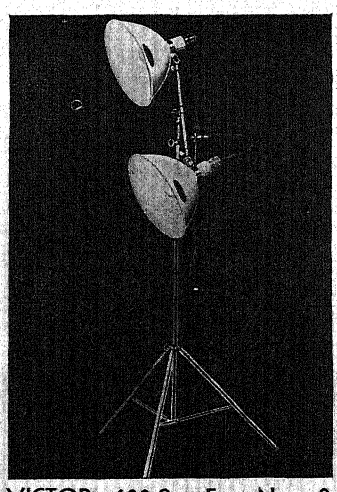
KODAK PHOTOFLOOD CONTROL. A 4-outlet, 3-switch control for No. 1 and No. 2 Photoflood lamps which works on the "hi-lo" principle. One or more pairs of lamps may be used in series at about half light voltage, or in parallel at full voltage. Prolongs life of lamps. Capacity is 15 amps. Works on 100-125 volts, A.C. or D.C. Price around $5.00



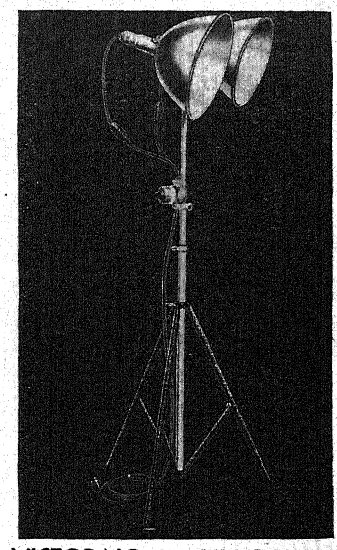
NU-LITE UNIT. Three separate lamps, each on collapsible nickeled stand up to 6 feet in height. Nu-lite (right top) has semi-focusing arrangement and raising and lowering of bulb through adjustable socket. 7-inch diameter of reflector, 6½ inches deep with vent holes. Takes 500-watt T-20 and No. 1 or No. 2 Photofloods. Basic-lite (left below) has 8-inch reflector, 4¾ inches deep, uses No. 1 or No. 2, and has centering device. Reducing diaphragm (above left) has 3-inch diameter. Edge-Lite attachment (right below) has 4 shutters. Made by Acme-Lite Co. Complete as shown with case, around $45.00.



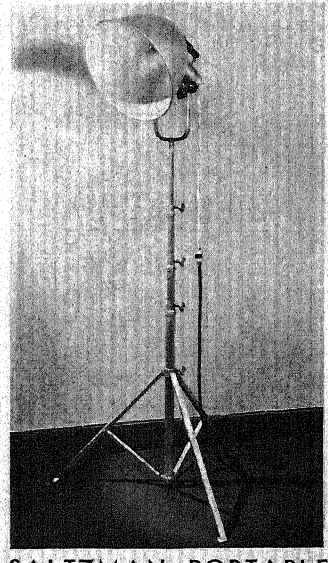
AGFALITE. Supplementary light stand. Pantograph mechanism carries lights quickly up to 94 inches from floor, stops anywhere without fastening nuts. Horizontal adjustment of lights from 11 to 36 inches. Fits into case, weighing 23 pounds altogether. Centered for No. 2 Photofloods, but adapters for No. 1. With diffusing screen and 2-outlet plug, around $25.00



VICTOR 620-S. For No. 2 Photofloods. Has two 9-inch diffuser reflectors, 4¾ inches deep with white enamel finish. Full swiveling cross arm attached to 2-section 6½-foot stand. Around $9.00



VICTOR NO. 290 HI-LO TWIN REFLECTOR. For No. 2 Photoflood lamps. Two 12-inch reflectors on swivel cross arm with leads of 10 amps. Hi-Lo switch clipped to Victor No. 0 3-section telescopic stand elevating to 7½ feet. Around $15.00



SALTZMAN PORTABLE FLOODLIGHT, 30-E. Can use 1000, 1500, or 2000-watt bulbs. Equipped with diffuser. Flood bowl and cable easily detached and are all packed in fiber case. Complete, around $90.00

LIGHTING AND STUDIO TECHNIC FOR COLOR ADVERTISEMENTS

Paul Outerbridge

Commercial Color Photographer; Former Color Editor of U.S. Camera Magazine; Author of Photographing in Color

One of the country's successful commercial color photographers tells about photography for advertisements in color—with special emphasis and diagrams on lighting. It is an interesting and growing field, though a difficult one, and Mr. Outerbridge traces the problems from the original visual through the finished print. Lighting, models, make-up, layout, props, and processing are discussed. Because of the increasing use of color in national advertisements, this should interest all readers.

All illustrations by Paul Outerbridge. For color photographs, see pages 2260, 2261, 2262.

See Also Advertising and Illustrative Photography, Color Photography articles, Commercial Photography, Lighting, Model Direction

IN NO OTHER BRANCH of color photography are the imagination and ingenuity of the photographer taxed to a greater degree, if as great, as in commercial advertising. His assignment may call for anything from a still-life suggesting the most sophisticated technic of the modern French painters to the authentically spontaneous atmosphere of an actual news shot. Idea men and copy writers in agencies, with the cooperation of layout men in the art department who are expert at dashing off visuals in pastels or water colors, can and do dream up situations and pictorial compositions that call for the greatest ingenuity and resourcefulness on the part of the color photographer, in order to translate their ideas successfully into the medium of photography.

The mechanics necessary to their successful execution may often be little short of those required in the motion pictures. In fact, they parallel them insofar as the same factors are all involved—such as knowledge of set building, decoration, casting, make-up, lighting, and, of course, pictorial composition which comes of a varied and adequate art background. The position of the top ranking commercial color photographer is relatively synonymous with that of the motion picture director. The fact that he does not have to develop a story sequencially in action, as does the motion picture director, is counterbalanced by the fact that he must be largely his own art director and producer—by way of financing and cost estimation—as well as laboratory expert or technician.

In order to be able to handle almost any job he must carry a heavy financial overhead. Unfortunately, due to color in photography becoming more common all the time, more people are constantly entering the field, competition is keener, and the prices obtainable for color work are rapidly becoming lower. Kodachrome brought adequate color within the range of many semi-amateurs who had never even mastered the technic of black and white photography. Buyers, especially in the editorial field, were quick to take advantage of the fact that the veriest amateur may by chance occasionally hit on a good thing. In the advertising field too much is at stake—with rigid deadlines for deliveries and costly reserved and sometimes paid for magazine advertising space—to take chances on a newcomer's ability to come through. By and large, the bigger, more important jobs go to the seasoned professionals because of their background of experience and knowledge acquired over a long period of time.

AGENCY PROCEDURE AND LAYOUTS

In the old days, a photographer who was by reputation a creative artist might have been called in to create an appropriate and significant portrayal of a product for commercial purposes in magazines. The composition of the picture and even the idea for it were often left to him to work out. However, advertising agency procedure has moved along and changed considerably in the last twenty years. Statistical and research departments have become more important, and a technic has been evolved for avoiding mistakes and eliminating a lot of the old guess work. As color photographs requiring numerous models and expensive backgrounds are a pretty costly procedure, in current practice a number of ideas are visualized in quick colored sketches which are passed on by various specialists in the agency and finally by even the client himself. When at length one has been chosen as meeting the necessary requirements, it is then—and not until then—that it is given out to the color photographer to execute.

These layout sketches may be executed with the greatest degree of care and perfection or they may be very rough, depending upon several factors: the policies of the agency and its own particular technic of operating, in how much of a hurry they were done, and how much confidence the agency has in the ability of the photographer. As we all know, this is an age of specialization and different photographers are chosen for different types of jobs. Probably this selective procedure has been overdone, because by and large a first-rate man is just as apt to do a skillful job on one type of subject as on another.

When the layouts have been carefully executed, the greatest and most painstaking effort is sometimes required to carry them out, or, in fact, to *interpret* them through the medium of photographic optics and color emulsions. When they are of a cruder and more unfinished character, wiggly lines of a pastel stick suggesting atmosphere must be translated into appropriate actual facts of photographable material. Sometimes it is desired that this be done in such a manner as to cause them to return to suggesting the wiggly lines atmosphere of the original layout. The transition from one medium to another requires at times the subtlest and most expert knowledge, together with the most mature taste, for things are very different in photography from what they are in a colored drawing. What may look very well in one medium may turn out very badly in the other.

These days a great many art directors have cameras and do quite a bit of photographing on their own, which gives them at least some background concerning photographic procedure and the particular advantages and limitations of the medium. Certain photographers have resented this at times on the theory that a little learning is often a dangerous thing, and an art director is liable to try to take the pictures for the photographer and be more of a hindrance than a help to a final successful result. It is becoming increasingly recognized that almost anything that can be drawn can also be photographed, only to do the latter often requires a great deal more work, the costs are infinitely higher, and in the end the results are not always what were hoped for or expected.

STUDIO VS. LOCATION

The ideal set-up for doing commercial color photography involves a combination of a large studio in which practically any set can be constructed and compact, fast-working, and easily portable traveling equipment which permits recreating studio conditions almost anywhere. When I say a large studio, I mean one in which motor cars and trucks may be driven in and photographed against almost any background—even the Grand Canyon if required. This kind of studio should be equipped with a prop and paint shop containing a complete set of machine tools and an artful and thoroughly experienced prop man who can simulate a great deal with the greatest economy of material and means. He should have a thorough knowledge of carpentry, construction, and painting and know such neat technics as the mixing of sand and sawdust with glue and water color paint to simulate stucco or stone. An adequate staff is required to accomplish the fifty and one different things that need to be done all at one and the same time preparatory to, during, and after the shooting. No matter how many men there are, one girl is practically essential for dealing with models, secretarial work, and other matters that women handle better than men.

CAMERA EQUIPMENT REQUIRED

Either a 5 x 7 one-shot color camera or a view camera for 5 x 7 or 8 x 10 Kodachromes are those most generally used for commercial work, although the Graflex, Graphic, and even miniatures may be required for certain types of shots. Of the one-shot cameras, the Devin and the National Photocolor are the most popular; there are also some revamped later models of the old Recmeyer in current use. For still-life all that is required is an 8 x10 view camera with a 5 x 7 back and a set of tri-color gelatin filters mounted in a cardboard filter holder. Of course, if one is doing much of this type of work it would be better to have the filters cemented between glass. However, such simple equipment will not do for any kind

of still-life that might move due to the heat of the lights—such as flowers. Needless to say, even for Kodachrome a lens highly corrected for color, such as the Apocromatic Tessar, Schneider Zenar, Eastman Kodak's Ektar, is necessary.

A thoroughly solid and rigid tripod of the heavy motion picture variety is best, for with one of these the photographer can be sure that when he is set up on a shot everything will remain as desired until all the exposures have been made. As color is still slow with Kodachrome having a rating of Weston 10 in daylight and Weston 5 in artificial light, a good tripod is practically always necessary. All new negative emulsions should be checked for exposure and balanced times of development before they are used on a job.

LIGHTING EQUIPMENT

Lighting equipment for commercial color work may be as elaborate as anything used in the motion pictures in Hollywood. It may be made up of batteries of 5000-watt lamps with Fresnel lenses and 2000-watt spots for large sets with five or six models, or it may be of a much less powerful and elaborate nature if only still-life is contemplated. Personally, I am inclined to believe that although floodlighting is thought to give the best negative quality, flash lighting may be so well used that it will give practically as good quality. It certainly entails less current consumption, heat, and heavy equipment and permits of recreating or reproducing studio conditions almost anywhere. Floodlighting will, of course, be the most satisfactory for still-life subjects (Fig. 1). But here again, as exposures may be greatly lengthened, nowhere nearly as much light is required and consequently this sort of work may be done almost anywhere.

The greatest exposure efficiency for the projecting of flash lighting is obtained by the use of at least 24-inch optical mirrored glass reflectors in large lamp housings, similar to those used for the 5000-watt. This equipment is heavy and cumbersome and not suitable for transportation for location jobs. However, 18-inch matte-etched aluminum Victor reflectors are very satisfactory for No. 75 flash lamps, as their parabolas have been well calculated for maximum light volume with minimum hot spot. For greater diffusion but much less efficiency, perhaps less than one-half, the Sunray lamps are practical, and regarding smaller units, for portability and lighting efficiency I have seen nothing to surpass Eastman's simple, inexpensive Kodaflector. Overhead and vertical strips of these may be assembled that will project very useful bands of even illumination.

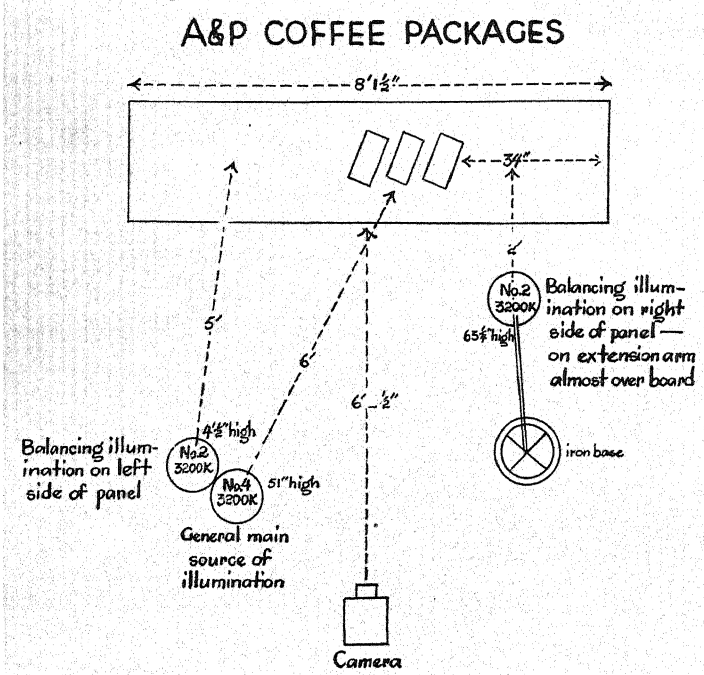


FIG. 1. For still-life work in color ads, floodlighting is entirely satisfactory. Here is a typical set-up, showing the illumination scheme for a small photo of A & P coffee packages. Kodachrome was used and it was made for a strip at the bottom of an ad layout to accompany a much larger main illustration showing two men and two women having iced coffee on the deck of a yacht. The Weston reading was about 7 (at Weston speed 6) and three exposures were made at f/32—4, 5, and 6 seconds for each. The 6-minute exposure was the best

I have found in general practice very little synchronized flash is required and that an open-shut exposure

making use of the 1/25 to 1/50 duration of the flash of the bulbs is generally entirely satisfactory. Absolute certainty that every one of the bulbs will fire requires wiring in series, but this makes for a very complicated set-up by way of shifting over from the pilot lighting to the flash, and it entails double the space and weight for cables, plugs, etc., and with not enough advantage gained to counterbalance the extra inconvenience. Pilot lighting may be done with 100-watt bulbs as a substitute for No. 21 flashbulbs and 300-watt bulbs as a substitute for the No. 75 flash, and there should be a sufficient amount of light on the subject to obtain a Weston reading of 13 for an exposure at f/22 with a one-shot camera having a Weston rating of approximately 5.

In using flash lighting it is always desirable to keep the set constantly illuminated with one or two pilot lights indicating the directional quality and general appearance of the final lighting. This enables one to watch the lighting on the subjects fairly accurately up to the moment of exposure, and eliminates the staring expression in their eyes which occurs when the pupils open up in the dark.

THE LABORATORY

An air-conditioned cold room is required for standardized operation of the carbro process and a regular schedule of production. With wash-off relief this is not necessary. For Kodachrome, theoretically only a darkroom in which to load the film is an absolute necessity. For Dufaycolor, black and white negative developing equipment is adequate. A minimum of two rooms is necessary for the production of color prints. The usual tanks, trays, and a precision enlarger with controlled voltage suitable for color are essential, and so is a pure quality of really cold water.

Cleanliness is important in the operation of a color laboratory, as work is executed to a standard of much finer tolerances than is black and white. All color materials must be constantly checked, because carbro materials especially have a most disconcerting way of varying periodically. They are certainly much better and more to be relied on than they were some years ago, and although their manufacturers are undoubtedly constantly seeking to standardize quality, if the photographer relies too much on the manufacturer of any color material he may find himself subjected to the most trying difficulties at the most inopportune time.

MODELS

To meet the demand for a variety of pretty and glamorous girls and suitable men, various model agencies have sprung up. The first of these was Powers. Others are Conover, Thornton, DePina. These agencies undertake to furnish a variety of types on a commission basis, paid by the model. Whereas through friends or other connections models might be obtained more reasonably in a somewhat amateur way, it is difficult to be certain of their dependability. The models booked through an authorized agency may be depended upon to be at the studio or location at the scheduled time with the proper clothes, a knowledge of their business, and what is expected of them in the matter of signing release forms, etc. This release, signed by the model at the completion of the job, relinquishes all future rights the model might have in his or her pictures and gives the photographer the right to reproduce or make any use of the photographs as seen fit. For release form, see page 2245.

Yes, when one is doing photography as a business and has a great many factors to be reckoned with (not the least important among them, fixed times for shooting and delivery) in the long run professional models are by far the best. The better women models get $5.00 an hour, the men get $5.00 for an hour and a half, but when a bathing suit is worn by either a man or woman there is an extra charge of $5.00 on the entire job. When certain models are in great demand due to their having appeared frequently on magazine covers and clicked with the public, they ask and get $10.00 an hour. In general practice, and especially in multiple figure compositions, these higher priced models are not necessary. Models who are used a lot and who always appear the same in their photographs usually have short careers, as there is a constant demand for new faces.

MAKE-UP AND COSTUMES

Most models know how to make up for the camera to quite an extent, and they usually have a container of Max Factor's pancake make-up with them. Of late I have been inclined to favor Westmore's Technicolor Make-up, which was used in *Gone With the Wind* and many of the major Hollywood productions. It appears to be suitable for most color work, is reasonable in price, and does a satisfactory job. The No. 15 with Continental powder for women of medium coloring will give a light effect against a light background. No. 16 with Copper powder will provide a most vigorous complexion, and No. 17 still more so. No. 25 seems to be excellent for men and even women against dark interior walls or outdoor backgrounds lighted by the blazing sun where a real sunburned, healthy complexion is desired.

The amount and depth of make-up used may be largely dependent upon the darkness or lightness of the costumes worn or the surroundings. For example, if the subject is dressed in a dark costume, like a Navy blue, that reflects very little light, quite a bit of exposure may be required to render the texture of the fabric with sufficient detail on the negative. Although a great deal of extra light may be projected into the costume to bring it up within a closer exposure range in relation to the face of its wearer, with flash a certain amount of light is bound to spill over onto the face. If the face is overilluminated it will be overexposed, and consequently burned out or very pale. By giving the model a rather dark, heavy make-up, like Technicolor No. 25 GR-6, the exposure value of both the face and the costume may be brought into closer relation and more natural flesh tones arrived at in the final result (see articles on *Make-Up*).

Most models can secure the clothes that are required of them. They seem to have a system of borrowing what is needed from one another or from somewhere. When this cannot be done, or the clothing required is of a too specialized nature, costumes will have to be rented from a costumer. When it comes to uniforms of the Army or Navy especially, entire and complete attention to authenticity is necessary, and they must be checked carefully before they are used. The Navy and War Departments are very cooperative about this.

PROPS

The obtaining of properties is often a problem. The income bracket of the audience to be appealed to determines the quality and styling of the props. Commercial color photography encompasses such a large field of possibilities that almost anything imaginable may at one time or another be required. In the larger studios there is usually a girl called a stylist who takes care of this matter, and her main asset is having built up files of information about where almost anything can be found. It is really surprising what can be found if you know where to go, but it takes time to build up files of this sort and to track things down to what often appears to be their hiding place. Many antique dealers will rent pieces of furniture and bric-a-brac at ten percent of their priced value, but when it comes to draperies, curtains, and carpets, these latter furnishings become much more of a problem.

The difficulty of obtaining the required props is further enhanced by the fact that very often they must be secured out of season. In this business it is generally the case that models are perspiring in fur coats, sprinkled with artificial snow in summer heat, or freezing in the winter in bathing suits on beaches—for pictures to be seen in the forthcoming hot weather. This difficulty of working out of season applies also to fruits, flowers, vegetables, grain etc. A competent express company that is accustomed to working quickly and on short notice, handling things reliably and carefully, is an essential for delivering and returning props.

At least a rough working knowledge of periods and interior decoration is required on the part of the photographer, and of course sufficient taste to know how to furnish a set artistically and charmingly. Much research is often necessary to gain required authenticity and realism, for any kind of a background may be required from, let us say, the interior of a modern factory or an old-fashioned blacksmith shop, to an entirely authentic operating room in a large hospital

or a modern family kitchen. Even the finding of a desired piece of furniture may not be sufficient because it may not be obtainable in the right color. This may easily entail shopping for a fabric that will harmonize with the color scheme planned for the picture and covering the piece of furniture. This requires the services of a competent upholsterer and preferably one who has worked for the camera before, because in doing a job of this sort it must be visualized entirely with regard to appearance and no more need be done than will show in the photograph, and that only well enough to last throughout the shot. The fabric must necessarily be applied in such a way as not to damage the upholstery of the piece, which has to be returned just as good as new to the place from which it was rented.

CARBRO VS. KODACHROME

Whereas I think sharper reproductions are obtained from Kodachrome than from carbro prints, it does not afford any latitude for suggested or desired corrections or alterations in the final result. When Kodachrome first came out there was a tremendous swing to it, but since that time one of the largest and most successful color photographic studios reports that less than twenty-five per cent of its work is done in Kodachrome, and various agencies that have tried using it have gone back to prints. On the other hand, one hears that a great deal of work is being done in Kodachrome and that the quantity used is constantly on the increase. I am inclined to feel, to a certain extent at least, that prints reflect the more personal touch of an individual photographer—that is, if he personally supervises the retouching on them—because he can alter values and even colors to suit his taste and more closely arrive at exactly the result he wants.

For certain lower-priced jobs, some photographers shoot a set of separation negatives in the one-shot camera and then a Kodachrome as a color guide for the engraver. The plate holder containing the Kodachrome is inserted where it will receive the reflection from the first mirror and consequently the most light. The filter is of course removed and a sheet of clear optical glass of the same thickness as the filter substituted. The Weston rating of the Kodachrome is lowered to around Weston 3, but tests with individual cameras are required for finding the exact Weston factor.

Adequate manpower is required for assistance at the time of shooting multiple model shots. The cost of model fees, the value of account executives' and art directors' time preclude the possibility of having a sitting drag along.

FOLLOWING THROUGH AFTER SHOOTING

After the shooting, the next step is to develop the plates with the greatest care in regard to contrast balance or density range, and make black and white prints from one of the negatives in each set. Usually the green filter negative or red printer is used for this purpose, but it depends upon the subject matter and which print will give the best and most natural black and white rendering of the subject. These prints are rushed to the agency, where they are submitted to the art director. From him they go on to the account executive and often to the client himself for the purpose of selecting the best all-around result from the point of view of the models' expressions and poses and that shot which is considered the most satisfactory for getting over the story and, of course, selling the product.

As soon as one has been selected, this set of plates is carried through to a carbro print which often must be to an exact size, such as fifty per cent more than the final reproduction size. While the print is being carried through, the other art work and type to accompany it in the finished advertisement can be drawn and set up in scale so that the whole may be pasted together for final inspection. Of course with Kodachrome, which it is safer to expose three times on each shot (once for the most carefully compared and calculated exposure meter reading, then a half-stop under and a half-stop over), the photographer's work is at an end when the film is packed up and sent off to the Eastman Kodak Company in Rochester.

THE JOB ITSELF

Commercial color photography is no field to go into for a person not possessed of health

and the strength of a horse, and he must also have the ability to keep track of a hundred and one details at the same time. He must occasionally be able to work very long hours, but the work is so interesting from a number of angles that the hours slip by without one's realizing the passage of time. It is a mistake to believe that commercial photography is other than a tough job, for if you try it you will find out it is. However, it is probably no tougher than many jobs, and perhaps a more interesting way to make a living than many other ways.

THE COLOR ILLUSTRATIONS

Kitchen Scene. (Page 2260, Color section.) The layout called for a group of men having a midnight snack, perhaps after a poker game, in a kitchen. Two ways presented themselves for doing this composition: One, to build the kitchen in the studio, which would have entailed considerable expense

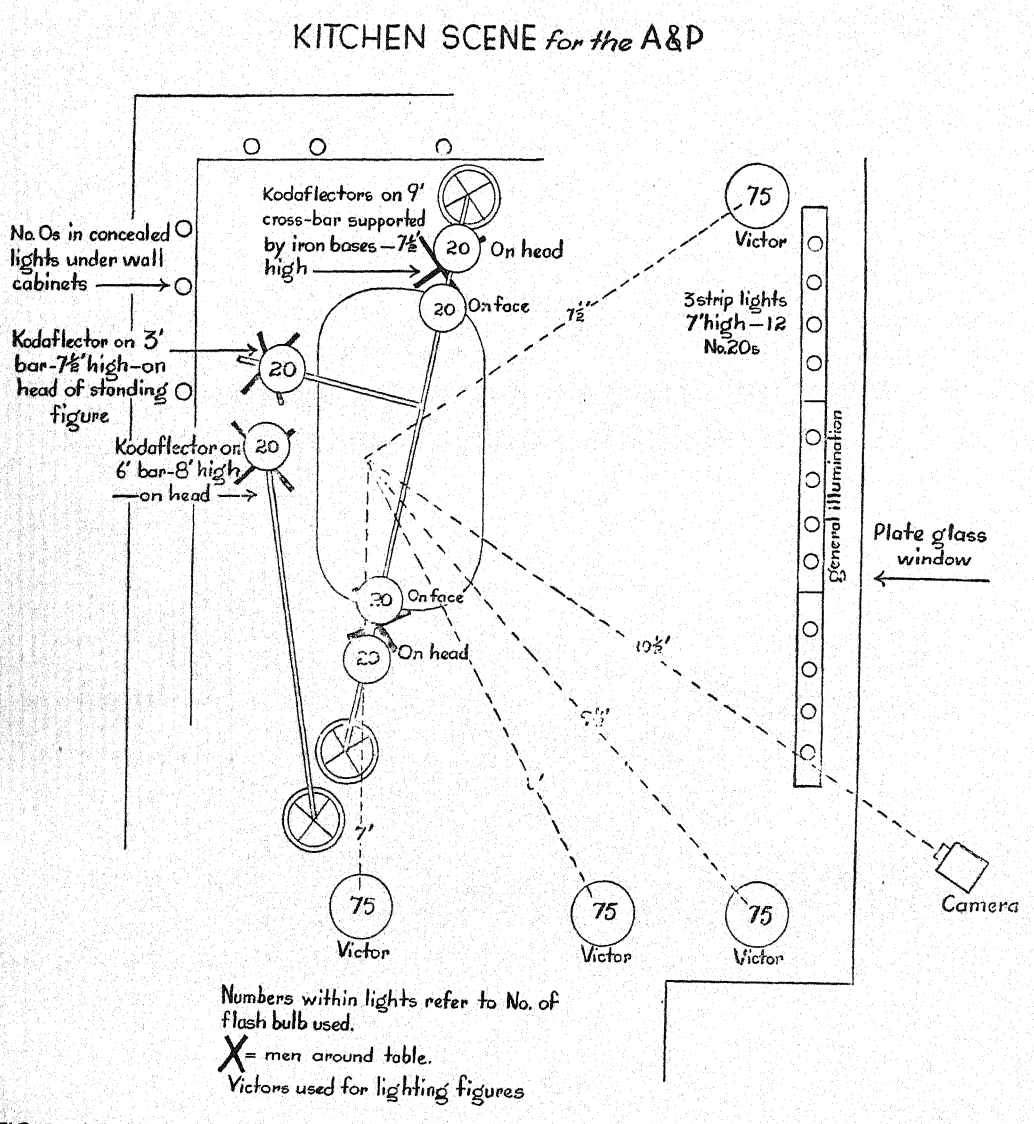


FIG. 2. A lighting diagram for the color gravure illustration "Kitchen Scene," on page 2260. The problems for this scene were many—not the least of which was the fact that the camera had to be set up the other side of a plate glass window

due to the transportation of a great deal of not-easily-rented, heavy prop material. The second method that presented itself was to find the set already made—in other words, find a kitchen.

However, the average kitchen is not large enough to permit of getting the camera far enough back (away from the part to be shown) to photograph it, but there was a way out that has been used by commercial photographers for some time. This was merely a question of finding a display room of kitchen furnishings, and, in this instance, in order to photograph the particular kitchen finally selected, it was necessary to set the camera up out in the hallway of the building and photograph through the plate glass window of the display room. In order to photograph in any display room it is necessary for the photographer to have his plan of action and arrangement of lights clearly in mind beforehand so that the lights can be placed and the scene set up for work with the least possible delay to avoid tying up the showroom for any longer than is absolutely necessary. To accomplish this involves having sufficient manpower on hand.

The set was realistically furnished, of course, and the china, etc., had to be found in an appropriate color scheme. The models were carefully selected and passed on for type, and they were made up with Max Factor Pancake, Tan No. 2. A minor problem involved was keeping htem from eating up all the cheese and crackers before the shots could be made. (Fig. 2.)

The same lighting equipment was used as shown in Figure 1 (page 2334). Six exposures were made with open-shut flash between f/22 and f/32. In this instance the Weston reading was 80 because No. 2 and No. 4 flood bulbs were used as pilot lights: No. 2 for the No. 20 flashbulb and No. 4 for the No. 75. Since that time, for convenience in working anywhere under all conditions, I have changed to ordinary 100-watt bulbs as pilot lights for the No. 21 flashbulbs, and 300-watt bulbs for the No. 75 flash. The old No. 20 flashbulbs, now discontinued, gave approximately one-quarter of the light of a No. 75, and the new No. 21's give approximately one-third the light but with a longer exposure—nearer to 1/25 second than 1/50.

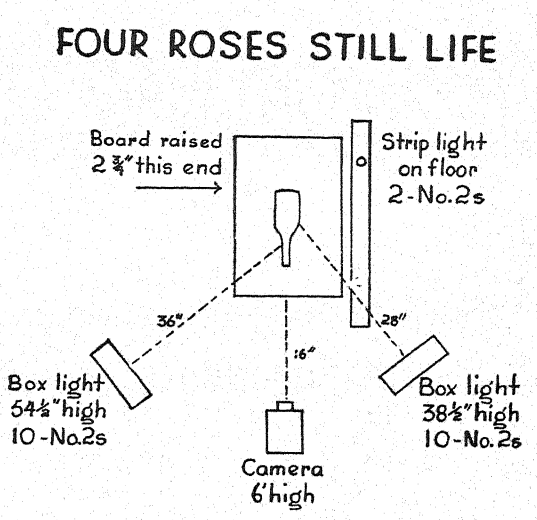


FIG. 3. This is the set-up for the color gravure illustration on page 2261. A detailed account of the procedure and problems is found in the text

The art director in charge of the account was present at the shooting and offered helpful suggestions.

Four Roses Still Life. (Page 2261, Color section.) On the face of it, this composition looks like a very simple shot indeed, but there is a catch in it as there usually is in all of them.

Beautiful water color layouts were furnished to work from for this series of pictures, but the difficulty was to translate these into photography successfully. Ribbons do not arrange themselves in the graceful curves that a painter can draw—in fact, they cannot be made to assume such forms at all without being carefully wired and taped. Neither do roses compose themselves in decorative arrangements without careful preparations.

For the background of this picture, boards were chosen with care for grain and color as it was necessary for them not to be too dark in color in order to vignette their coloring out into pure white paper. To arrive at their proper width in relation to the size of the bottle, the layout was focused in the camera with the bottle the size that it was to appear eventually on the groundglass. Then an outline drawing was made on the groundglass with a black china worker's pencil (soap with blacking in it). The camera was then refocused on the bottle itself, so that the

AFTER DINNER COFFEE *for the* A&P

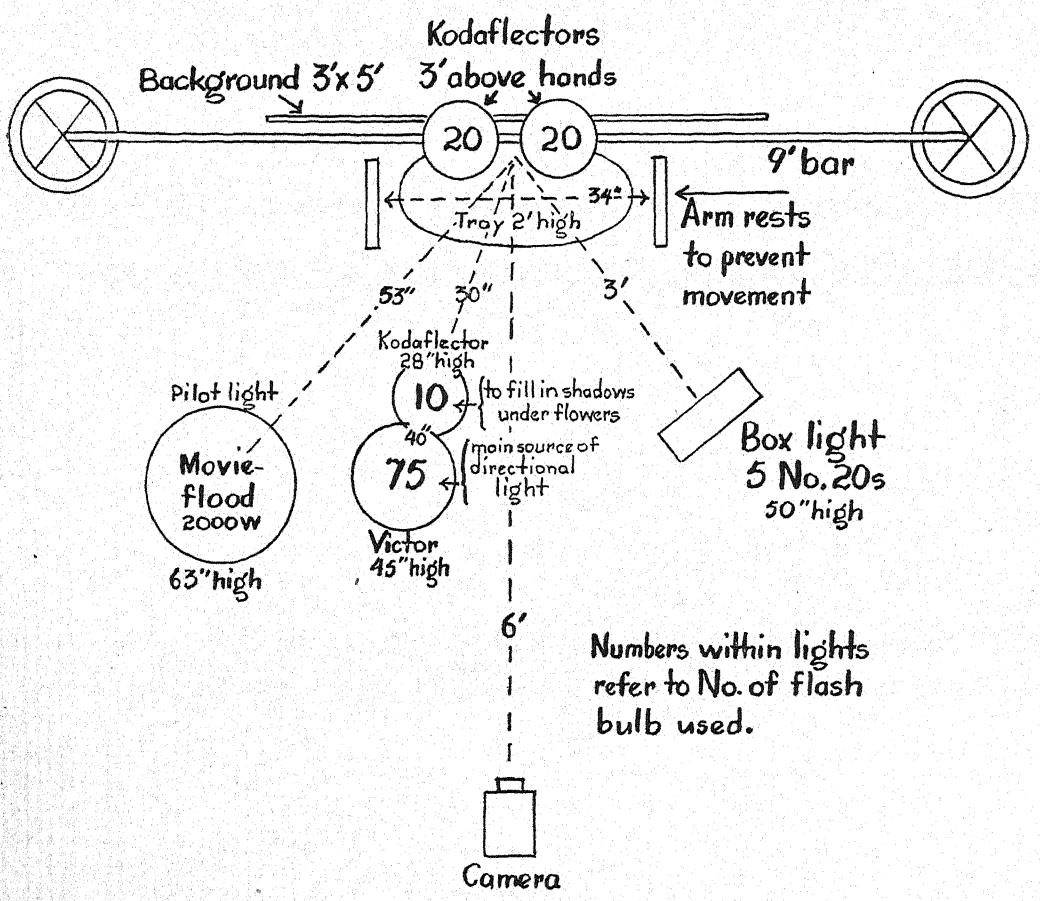


FIG. 4. The "After Dinner Coffee" photograph, reproduced in color on page 2252, was photographed as shown in the diagram. For details of the color scheme and how it was achieved, see the accompanying text

bottle fitted within the drawn outline and narrow strips of tape were stuck up on the wall to coincide with the drawing of the boards on the groundglass. This gave the width of the boards desired. Further than this, as the camera was to be tilted in order to correct the optical convergence of the lines, the boards were sawed slightly wider at one end than at the other. The vignetting was accomplished by painting and air-brushing on the boards and eventually rubbing off with an eraser any residue left on the temporary support paper.

This board background was then laid on the floor at a slightly tilted angle, and back of the bottle was placed a piece of gold foil paper to reflect light back into the bottle and enhance its luminous and appetizing atmosphere. The roses were carefully wired and bent up to face the camera as desired, and all the leaves were applied individually with cellophane tape and pins. Naturally, roses and leaves treated this way wilt very quickly, especially in the heat of closely placed photoflood bulbs. So the camera was focused and all the composition arranged on a dummy set first, when everything was carefully marked so that the final arrangement could be made by means of the marks. There was a lot of fussy, painstaking work necessary in connection with all these compositions. (Fig. 3.)

The illustration was made with a Devin one-shot camera, equipped with a Zeiss

Apochromatic-Tessar lens. Flood lighting was used, the lights being placed as in Figure 2. The exposure, made at f/32, was 5 seconds.

After Dinner Coffee. (Page 2262, Color section). The layout sketch for this shot indicated a white china coffee service decorated with a small floral border design against what appeared at first glance to be a plain background. However, this background was not entirely plain, but relieved of monotony by a variation of colored pastel strokes intermixed. This technic is typical of the medium of painting, and painters have used it for years in order to give light vibration to the background. If the background had been translated too literally into the medium of photography it would have resulted in a perfectly plain, posterlike ground entirely lacking in any atmosphere. If a background had been painted with various slightly different colored brush strokes and thrown slightly out of focus, it is true it would have suggested in the photograph somewhat the feeling of the original sketch. But in the end it would not have been photographic and would have resulted in a self-conscious mixture of mediums. In order to keep the background photographic and at the same time give it variety, a means of transposing, as it were, from one medium into another suggested itself in the use of a board of interesting wood graining in an appropriate color. This at once suggested substituting the greater richness and luxurious atmosphere of a gold china set for that of the white flowered china.

The red tray was called for in the sketch, but it was impossible to find a plain one as indicated. However, the design in the one shown enhances the luxurious atmosphere. The rest of the elements suggested themselves in appropriate forms and colors as the composition was developed around the original nucleus of the gold service against the grained wood with the red tray.

In dealing with the three A & P coffee packages over a period of time, it became evident that repeating the colors in the packages themselves in the main illustration proved a workable method of relating these two illustrations on the advertising page.

Arm rests were set up and the position of the arms carefully marked upon them so that they would return to the same position after the necessary delay in changing the flashbulbs, plates, etc., for each one of the shots. These also helped to steady the arms and eliminate any possibility of movement.

The lighting for this picture is shown in Figure 4. The Weston reading was 100, with the Devin camera stopped down to half way between f/22 and f/32. An 86-C filter was used, and the flash exposure was open-shut, the shutter being set on 1/10 second and the duration of the exposure being about 1/50 second.

LIGHTING, FLUORESCENT

Knut Vang

Commercial Studio Photographer, Brooklyn, N. Y.

A portrait photographer who has long been using fluorescent lighting in his studio work, tells about this comparatively new and easy form of illumination. The theory of fluorescent lighting and its uses are explained.

All Illustrations by Knut Vang.

See Also Lighting In Portraiture

FLUORESCENT LIGHTING seems to be the right answer for the modern photographer —particularly the studio photographer. It gives correct balance of light and shadow with little effort and expense. Fluorescent lighting also gives off highly actinic and cool light in comparison to the ordinary incandescent illumination and, although it is not as powerful (in foot candle capacity), it gives a more continuous spectrum.

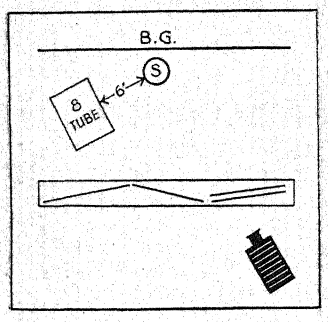
THEORY

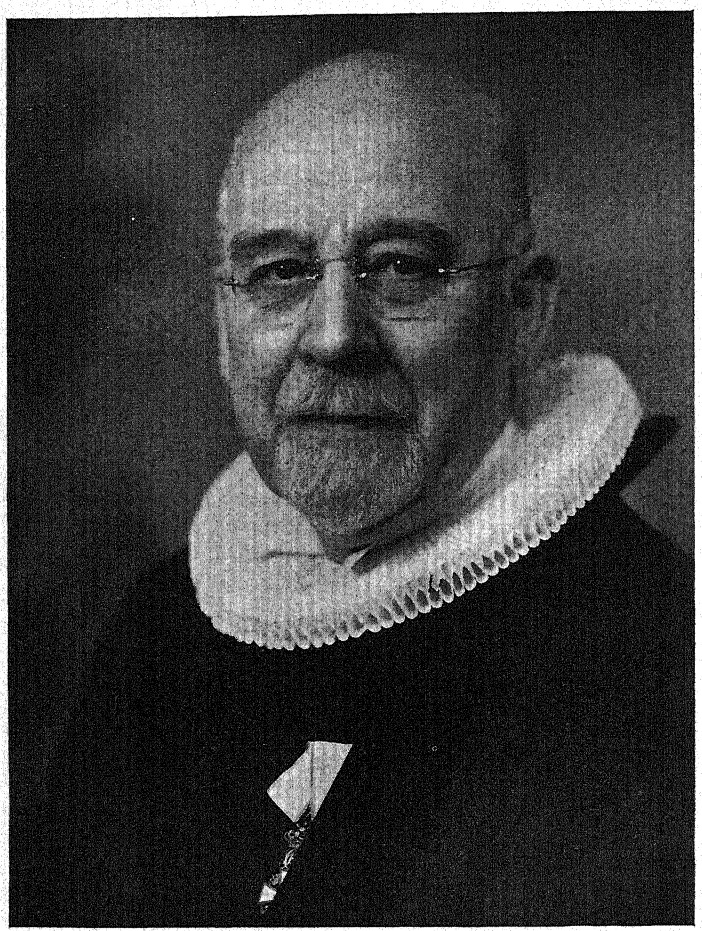
It is not necessary to go into technical description of fluorescent lighting, but a basic understanding of the theory will make its use clearer. Fluorescent lighting, developed in 1939 by General Electric, is based on fluorescence—the property of some organic solutions of giving off light when exposed to ultraviolet, cathode, or Röntgen rays.* In incandescent lighting, light appears in the form of and as a result of heat, but with fluorescence, the heat is absorbed.

Fluorescent lights always come in tubular form and the insides of these tubes are coated with fluorescent powders or phosphors. Inside the tube are electrodes (at

*Editor's Note: Fluorescent lighting should not be confused with so-called "black light." This latter is ultraviolet light thrown onto a fluorescent subject and is treated in the article on *Ultraviolet Photography*.

The lighting in this portrait of a clergyman is used a great deal—with light at an angle of about 45°. The floor light was 6 feet away to the subject's right and about 5 feet from the floor, high enough to avoid reflections in the glasses. Ceiling lights were about 13 feet from the subject. This produced a soft and mild effect. DATA: Portrait pan film, bulb exposure, f/9, eight 30-watt tubes on floor, four 40-watt tubes under ceiling

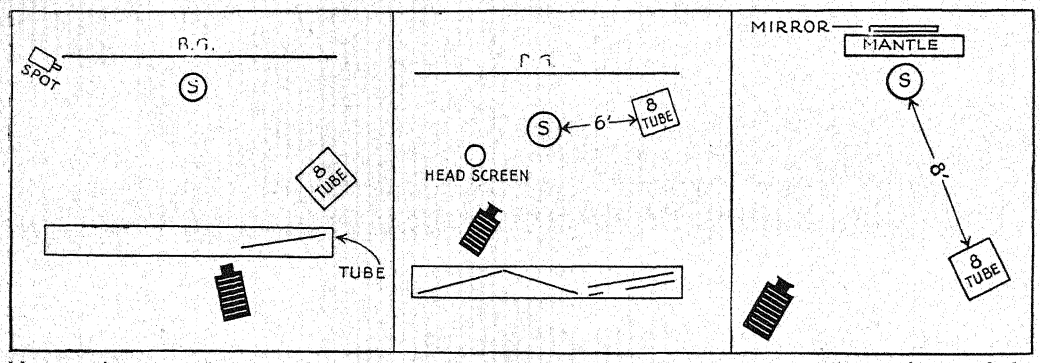




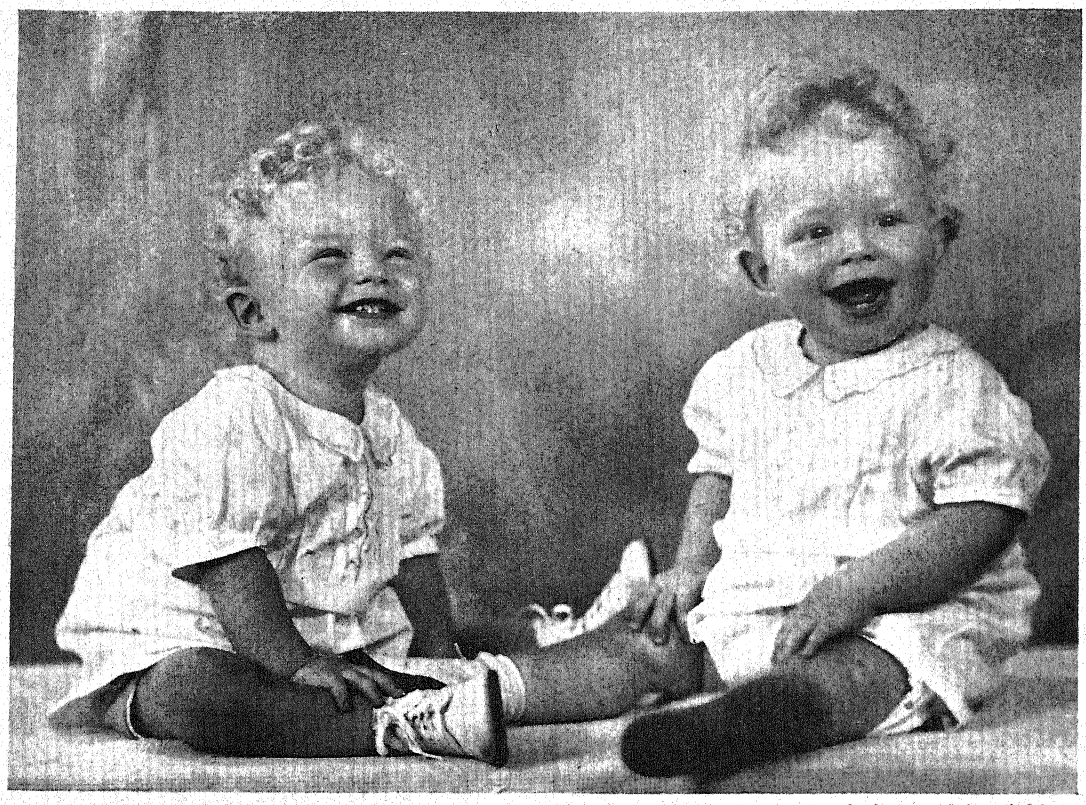
either end) and also mercury vapor and argon gas. When the current is on (with the vapor completing the circuit inside the tube), ultraviolet light is created, given out by the phosphors in the form of visible light. The color is determined by the light which the phosphors are capable of absorbing.

Phosphor	*Color of Light*
Zinc silicate	Green
Calcium tungstate	Blue
Cadmium borate	Pink
Zinc beryllium silicate	Blue-White
Magnesium tungstate	Yellow-White

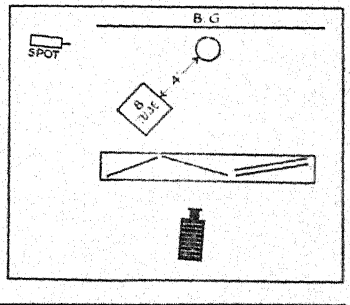
From this we can readily understand that fluorescent light can be controlled by inserting different colors into the tubes. And the studio photographer can get different effects by inserting different colored tubes into his stand.



Here are three more fluorescent lighting schemes. At the left is a more contrasty light effect, with a spotlight, the regular floor tubes, and only one ceiling tube. Center is an arrangement which is useful for profile studies. And at the right is an interesting lighting scheme using a mirror and the floor tubes only

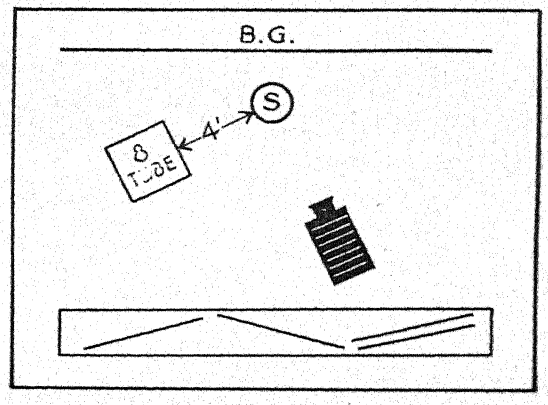


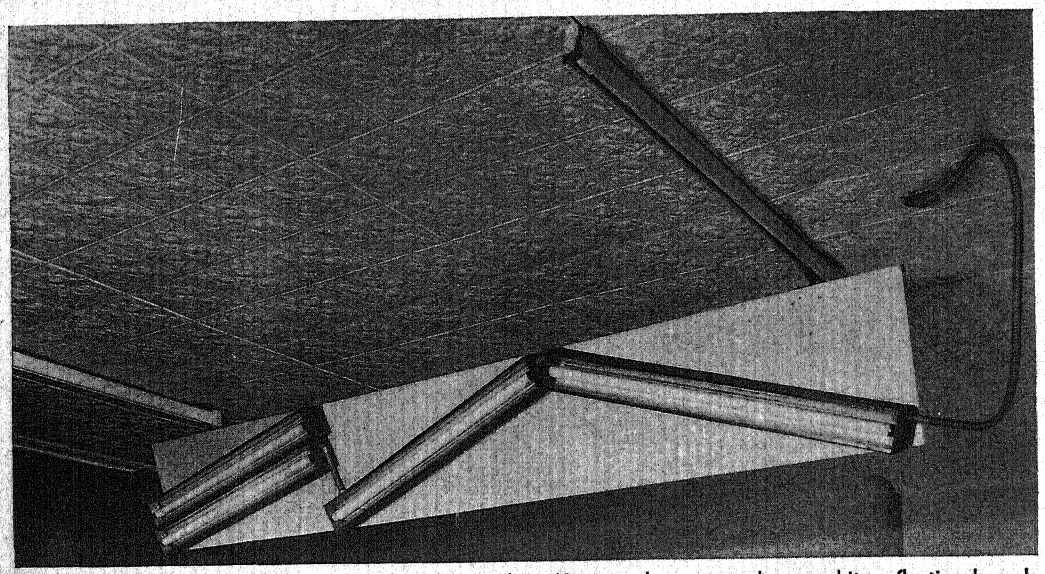
Fluorescent lighting is particularly good for children, as the light is both soft and cool. A high intensity of illumination is therefore possible, making action shots like this easy. The fluorescent equipment is thus adaptable for all types. DATA: fast ortho portrait film, instantaneous exposure, f/4.5, eight 30-watt tubes on floor, four 40-watt tubes under ceiling, spotlight at left





The conventional bridal picture is made much easier by the use of fluorescent light. Most pictures of this sort are made with a soft lighting effect. DATA: Portrait pan film, bulb exposure, f/9, eight 30-watt tubes on floor, four 40-watt tubes under ceiling





The ceiling fluorescent lights are arranged as shown—four 40-watt tubes mounted on a white reflecting board. Notice, too, that the entire apparatus may be moved forward on runners

The fluorescent tube is so easy on the eyes that it can be moved to a distance of 3 feet from the subject without discomfort. It is better however, to work farther away, as a close position is apt to make the lighting flat.

The regularly manufactured fluorescent lighting banks come in either daylight type (6500°K.) or the white light type (equivalent to tungsten). When the daylight type is used with Kodachrome, the Weston ratings for the color film should be changed as follows:

Kodachrome	*Type*	*Revised Rating*
35mm	Regular	Weston 6
35mm	Type A	10
16mm	Regular	5
16mm	Type A	8
Cut Film	Prof. Daylight	4

No change in Weston speed ratings need be made for black and white film, however. Filters are rarely needed for fluorescent lighting with color film, as the lighting ap-

(Continued on page following insert)

COMPOSITION ANALYSIS for . . . SAFE AT SECOND

This rare action shot shows Camilli, the Dodgers' first baseman, safe at second. It seems to derive its striking power from the sole fact that it pictures action—vivid, fast, dramatic. But look again and you will see that even the finest action cannot get along without its due complement of powerful contrasts, that action pictures are not exempt from the laws of composition.

The basic pattern is triangular. The base is formed by the left side of the white-uniformed player, the right side by a line running from the shoes of the umpire at the right to those of the one in the center, while the left side is marked by a line running from the heels of the second player to the same center point. This pattern is nicely repeated by the three dust clouds.

By way of contrast this triangle is rudely broken through by an enormously powerful dynamic movement starting with the heels of the second player and carrying right through to the cap of the umpire at right in one violent sweep.

Between these two essential compositions there are no fewer than five minor battles fought; here they are in order:

1) The umpire at left, the one in the center, and the two legs at left all bear down upon the white figure.
2) The two black suits versus the white uniform.
3) The white player pointing to the right opposed by the black figure rushing in the opposite direction.
4) The white figure from left knee to left arm, and upon it, in rectangular fashion, the black figure in the center.
5) The two legs at the left diagonally opposed by the two legs at the right.

There are also fine features of parallel effect. Look at the shadows, the two of the umpires, and the two of the legs at left. The black belt of the player on the ground parallels the black suit on top of it.

Many photographers, in catching such rare action scenes, are guided by instinct or intuition. But those who lack such gifts may more than make up by studying the effects of contrast and parallel lines. They'll never go wrong and stand to gain a great deal. As this picture shows, the essence of a great action shot is not any different from that of, say, a beautiful still-life photograph. Not the least of the merits of this picture is the fact that it is stripped of everything that might interfere with the dynamic action.

Gerhard Hirschfeld



SAFE AT SECOND

INTERNATIONAL NEWS

After hitting a double in a World Series game, Dolph Camilli is shown sliding into second as Yankee shortstop Rizzuto dives for the bag



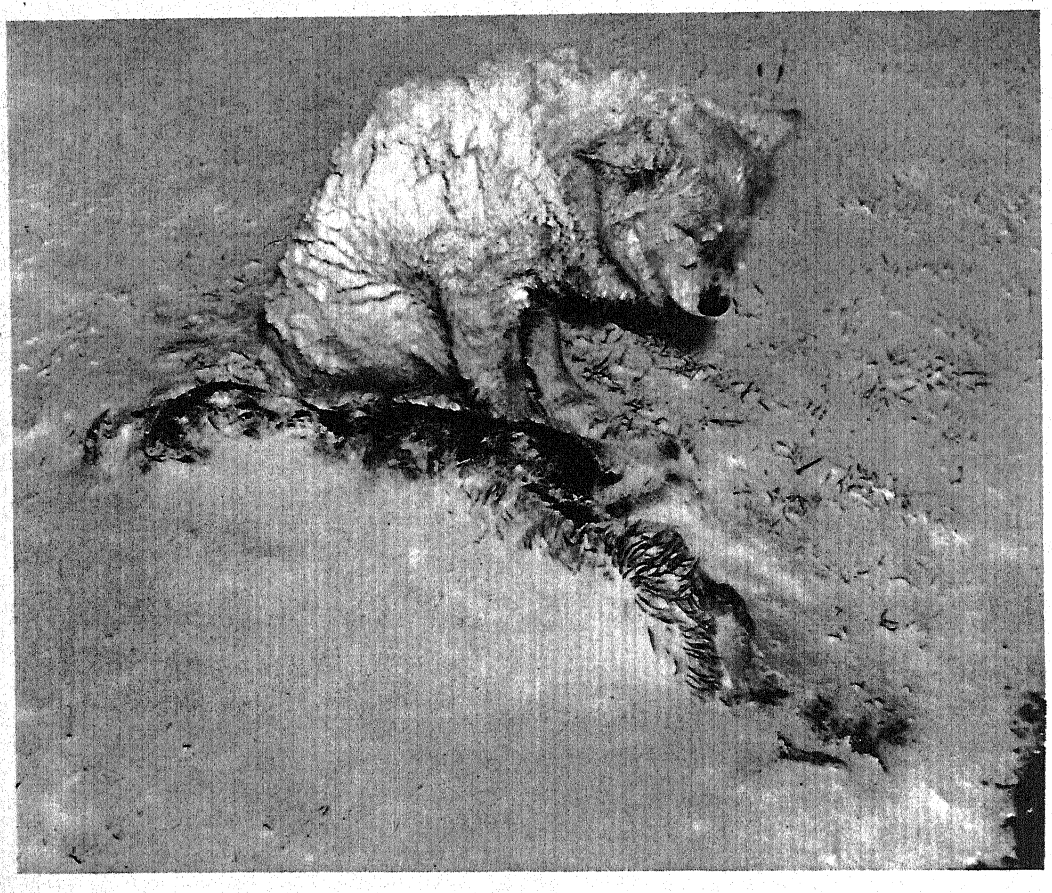
MAY O'DONNELL AND JOSE LIMON — BARBARA MORGAN

The grace and motion of the dance is caught in this speedlamp photograph. The dancers have been photographed when their figures composed into the simple form of the light upstretched leg of the girl and the firm, dark legs of the man



SCENE FROM *MRS. MINIVER* **VIRGIL APGER**

Here is the best posed production still taken in a studio, as judged by Hollywood Studios' Second Annual Still Photography Show. Much of the stirring feeling of the final scene of *Mrs. Miniver*, an M-G-M production, is conveyed in this interpretative still



VIGIL RUSSELL SCOTT

The unmistakable pathos of this picture makes it one of the best of animal photographs. It shows, simply, the all-night vigil of a weary dog for his companion. They were romping in the snow in a Flint, Michigan street—an auto came out of the storm, crushed one of them—but Porky, part spitz, part bull, would not leave—while the blizzard matted his dejected body he stood guard, refusing approach to the dead dog—a small boy ventured too near, got nipped—hours later, the young brother of Porky's master came along, called Porky, took him home—thus ending this vigil for a fallen friend. Taken for the *Flint (Mich.) Journal* by a staff photographer. DATA: Speed Graphic, Ektar lens, fast pan press film, Heiland flashgun, 1/100 second, f/16

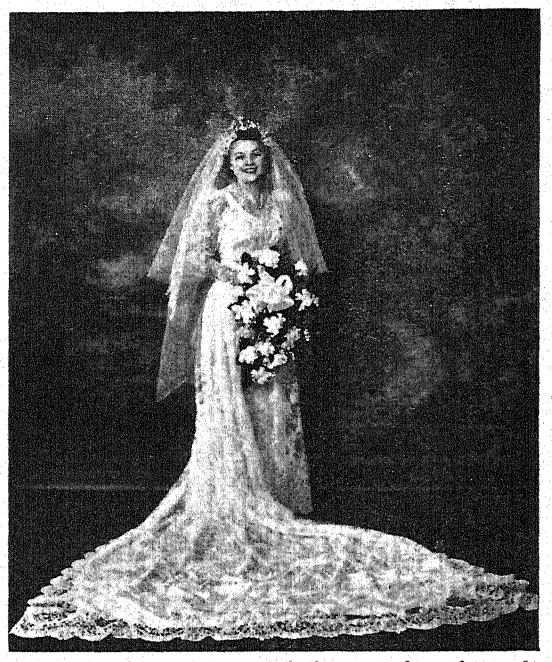
(*Continued from page preceding insert*)

proaches the qualities and color temperature of daylight as no other form of illumination does. It may be worth mentioning that the fluorescent light pays for itself within a very short time as the consumption of current is way below that of any other method of studio illumination. Any required light effect can be obtained, the only auxiliary equipment needed being a spotlight and a head screen.

EQUIPMENT

For general illumination, my ceiling light consists of one bank of lights of four 40-watt tubes mounted on a board. This is suspended from the ceiling and fastened to rails so that it can be moved back and forth. For the studio floor I selected a Perkins High Power 8-30 which is a bank of eight 30-watt tubes that can be raised or lowered or turned around in a complete circle. The bank can also be adjusted for a vertical or horizontal position. The bank of lights under the ceiling is divided into two circuits, three tubes on one and a single one on the other. This gives an opportunity to control the strength of the overhead light and to balance the light with the floor group.

Fluorescent light units—for a movable floor stand or for overhead suspension—are sold with one to eight tubes or more. These are regularly sold commercially by The Photogenic Machine Co. (Perkins Hi-Power lamps), M. Black Manufacturing Co. (Black Foto-fluorescent), and the Johnson Ventlite Company. General Electric also sells their Mazda "F" lamps—white, daylight, or colored—in tube form.



Here is a conservative bridal photograph, with simple lighting. The tapestry background was chosen to go with the lace gown. DATA: Portrait pan film, bulb exposure, f/9, eight 30-watt tubes on floor, three 40-watt tubes under ceiling





At the left is the lighting set-up which produced the portrait shown at the right. In addition to the large fluorescent floor stand and the fluorescent ceiling lights (not shown), the photographer used a regular spotlight and diffused daylight. Notice the soft effect of the lighting in the finished portrait

LIGHTING IN MULTIFLASH

Dale Rooks
Feature Photographer, The Newspaper PM

Flash photography everywhere—and particularly in the photo-journalistic fields—has been vastly improved by the multiflash technic. The author tells of simple experiments showing the effects of multiflash and single flash illumination. He tells of special multiple flash equipment, technics of light arrangement and exposure. The uses of multiflash at home, with portraiture, in the news or commercial fields are thoroughly covered.

All photographs by Dale Rooks unless otherwise credited.

See Also Banquet Photography, Flash—Elementary Technic, Flash Equipment, Group Pictures, Lighting

AMERICAN PHOTOGRAPHY was advanced to a new pinnacle of achievement by the invention of the flashbulb and the synchronizer in 1930. Literally "turning night into day," the flashbulb and the on-the-camera synchronizer were greeted with enthusiastic acclaim by photo-journalists, commercial photographers, and serious amateurs whose chins and faces all too frequently had been seared by exploding flash powder.

With the birth of synchronized flash photography, a new style of candid illustration, presenting intimate views of celebrities in their homes, at their work, and at play began to appear in American newsprint. Amateur photography lost its stilted posed appearance, so characteristic of yesteryears, taking in its stride high speed action indoors and capturing the most fleet expressions of child and adult. Glass enclosed flash, fired simultaneously with ultra-rapid shutters opened new picture vistas for the photographer, lessened the mechanical difficulties of his profession or hobby, and eliminated much cumbersome and expensive lighting equipment from his kit.

However, hardly had the flashbulb synchronizer left the fond hands of its creators —"Doc" Skinner of the *New York Journal*, Ernest Sisto of the *New York Times*, Clarence Stieglitz of the *New York World Telegram*, Tommy Flannagen of the *New York Daily Mirror*, and others—before an undertone of criticism and disappointment arose. "Flash pictures are unnatural." "Flash light kills all the highlights, flattens the features." "Flash pictures are chalky, lack tone and warmth." "Quality is impossible with the flashbulb." Whether justified or not, such were the remarks circulated by many of the more pictorially-minded photographers who claimed that flash photography was "all right for the press" but not for those who had a desire for artistic quality.

That flat light necessarily produces pictures lacking in quality is debatable. The technical perfection of flash pictures is dependent not only on the light source but on exposure, development, printing, and many other factors as well. Nor is it to be admitted that flat lighting itself is photographically undesirable, for a multitude of beautifully artistic and technically perfect pictures attest the contrary. An example of the quality, roundness, depth, and modeling possible with single flash synchronization is Figure 1, an informal child group study. This flash picture was taken with one flashbulb in the synchronizer on the camera. It must be granted, however, that one-source illumination from the camera is distinctly limited in its application, often producing unflattering shadows, flatness, unnatural appearances, and lacking the versatility and pliability that other more cumbersome lighting methods had possessed. Thus, at least part of the early criticism of flash pictorialization was merited.

Multiple flash photography was born of the numerous attempts of press and commercial photographers to mitigate the undesirable elements of single flash photography. The simultaneous use of several flashbulbs was suggested by observing the modulation and depth produced by two- and three-source lighting in regular portraiture and commercial photography and was used first without synchronization—that is, with the open-flash method.

The adoption of multiple flash photography gives adequate testimony to its effectiveness. Amateur and professional alike discovered the brilliance and increased lighting quality made possible by the use of one or more bulbs placed at a distance from the camera. They likewise discovered that more than one bulb could be synchronized to the shutter without the purchase of new equipment. The old synchronizer could do the job well.

Use also showed that with multiflash the true plastic quality and depth of a subject could be carried into more realistic reproductions and that larger groups could be recorded with more balanced illumination. Balance of lighting and control was made possible in flash photography by the use of more than one bulb.

MULTIFLASH VS. SINGLE FLASH

Like equipment in all phases of photography, the multiple flash outfit can be as complete and extensive as the photographer desires. Conversely, it can be as simple and inexpensive as he wishes. The quality of the picture is not proportional to the amount of initial expense—fine calibre multiflash pictures can be taken at no additional cost save the extra flash bulb.

For initiation into the new flash technic, a simple experiment may be tried. Here are the steps:

1. Any camera may be used and placed upon a solid support in the parlor. The camera should be directed toward an easy chair near a reading lamp and the distance indicator, if the camera has one, set at the proper reading for the distance from the camera to the chair. If the camera has a diaphragm, it should be set at approximately f/16, provided regular panchromatic film is used. The shutter should be placed at "Bulb." If the camera is a box camera and has fixed focus, the photographer should be certain that the camera is eight feet or more from the subject.

2. The subject—perhaps a member of the family—should be seated in the chair and the reading lamp adjusted so that the light falls partly on the hair and partly on the face. This can be accomplished by placing the lamp just ahead and to one side of the subject.

3. The regular light bulb may then be removed from the socket and the plug pulled from the wall, leaving the lamp switch turned on. A photoflood reflector or another lamp should be placed just above the camera lens and directed fully upon the subject. The regular bulb and plug of this lamp should also be removed. By means of an extension cord and double electrical outlet, the two lamps are connected with the current, after making sure that the switch on the extension cord is turned off. A No. 0 Wabash or a No. 10 G. E. flashbulb should be inserted in each lamp socket.

4. The multiflash set-up is now ready for use. When the subject exhibits just the right expression, the shutter is quickly opened, the extension cord switch turned on (thus firing both bulbs simultaneously) and



FIG. 1. THREE OF A KIND. Flash photo showing the quality possible by using one bulb at the camera. DATA: 4 x 5 Speed Graphic, fast press pan film, 1/200 second, f/22



FIG. 2. SIMPLE MULTIFLASH PHOTO. Compare this with the single flash photo of the same subject, Figure 3. Here reproduction of natural home lighting and modulation of features was made possible by the use of one bulb above the camera and one in the floor lamp. DATA: Kodak Vigilant 620, medium fast pan film, open flash, f/16

the shutter again closed. If accomplished correctly, the photographer has made his first multiflash picture (Fig. 2).

5. For comparison, another photo may be taken with the bulb in the lamp near the camera only. The single flash results should look something like Figure 3. The more true reproduction, naturalness, increased quality, and roundness of the double flash exposure is easily seen by comparison.

The experiment just suggested will serve a double purpose. First, it will acquaint the photographer with the differences and most obvious advantages of multiple flash; and second, it will show how simple and easy the newer flash technic really is. However, the full value of multiflash photography is not apparent until one uses the technic with the synchronizer.

EQUIPMENT

The photoflash synchronizer has the one function of tripping the camera shutter at the instant the flashbulb is fired. This simply means that at the instant the camera shutter is open, the flashbulb supplies sufficient light to record an image. The two must occur at one and the same time if the light from the flashbulb is to be effective.

Action pictures under any and all light conditions are possible only because the camera shutter and the flashbulb can be synchronized. With a modern synchronizer, the exposure may be extremely short, 1/50 to 1/1000 second or less, and the fastest action "stopped" anywhere, any time.

Modern synchronizers are of two general types. The first is the mechanical synchronizer, such as the Kalart or Ley, which utilizes a cable release and usually must be wound or cocked before operation. The second is the all-electrical type, such as the Abbey, Speed Gun, Heiland Sol, or Jacobson synchronizers which operate purely by electrical impulse, instigated by a push-button or buzzer. Either type of synchronizer is readily adaptable to multiple flash use (see *Flash Equipment Survey*, page 1798).

The mechanical synchronizers, which employ current to fire only the flashbulbs (a mechanical device releases the shutter) have been found capable of shooting as many as

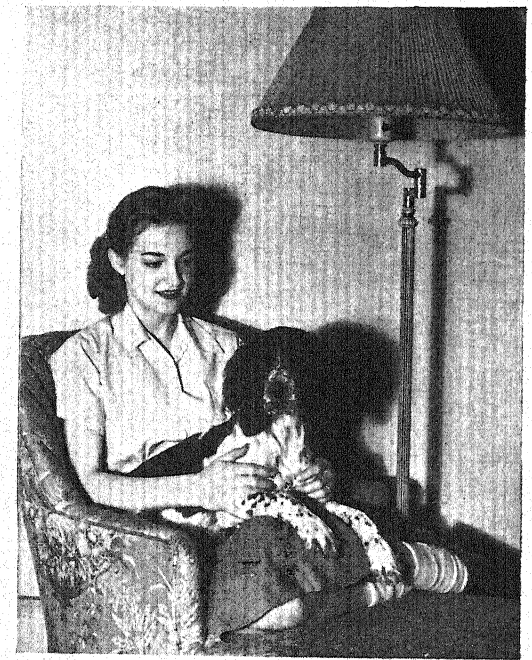


FIG. 3. SINGLE FLASH PHOTO. Note the deep background shadow and unnatural effect of the on-the-camera illumination. Compare this with Figure 2. DATA: Kodak Vigilant 620, medium pan film, open flash, f/16

five bulbs at one time, without too frequent battery changes. The more modern mechanical synchronizers, such as the Kalart Master Micromatic Speed Flash, are equipped with extra outlets for standard electrical insert plugs, as shown in Figure 4. For multiple flash photography, two ordinary photoflood reflectors, or any other type of light, can be plugged into these outlets and fired with the bulb on the synchronizer. Other standard mechanical synchronizers are similarly equipped.

The all-electric synchronizer, which uses battery current both to fire the flashbulbs and trip the shutter, is equally adapted to the simultaneous use of several bulbs, but

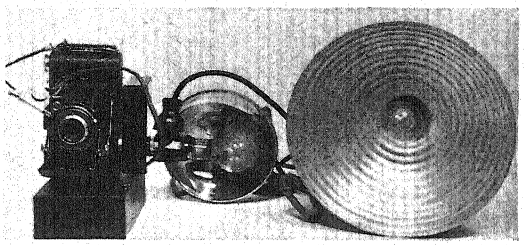


FIG. 4. MECHANICAL SYNCHRONIZER. The Kalart Micromatic Speed Flash Synchronizer and one extension flash unit on a Kodak Vigilant

fires only three bulbs consistently. The electro-magnetic shutter tripper requires the remainder of the available current. Extra outlets for standard electrical insert plugs are also a regular feature of the modern synchronizers of this type. Figure 5 is an illustration of one of the latest all-electric synchronizers with multiple flash equipment attached. Abbey, Speed Gun, Jacobson, and many other electrical synchronizers are furnished with similar features, some including 20-foot extension cords and tandem flash reflectors.

Perhaps the most practical and least expensive adapter is an ordinary triple plug, having one screw-in socket and two plug-in sockets. This is inserted in the bulb receptacle of the synchronizer and the extra flash cords plugged in the two side openings of the triple outlet. Such a three-way plug, which costs but ten cents, was used with excellent results by the author for two years prior to the introduction of the more modern synchronizers. This simple multiple flash unit is pictured in Figure 6.

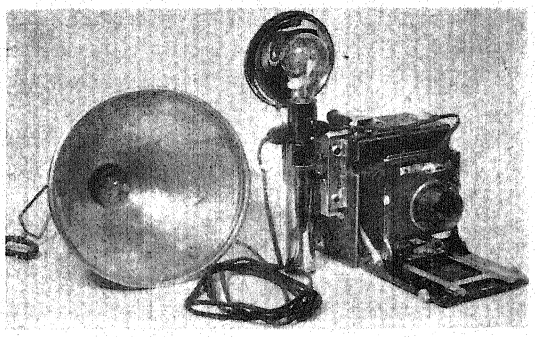


FIG. 5. ELECTRIC SYNCHRONIZER. The Heiland Sol Flash Synchronizer on the Speed Graphic, with an auxiliary flash reflector attached

The remainder of equipment necessary for a complete multiflash kit includes two ordinary clamp-on reflectors, a 15-foot extension cord with a triple plug-in socket on one end, a lens shade, and perhaps a collapsible light stand. The auxiliary reflectors should be equipped with No. 16 gauge wire or heavier. These can be clamped on doors, curtain rods, chairs, etc. or can be held by interested bystanders who are always willing to cooperate. A short length of wood is handy for the placement of lights without the use of an assistant. In fact, most anything will do for the support of lights so long as they can be placed properly.

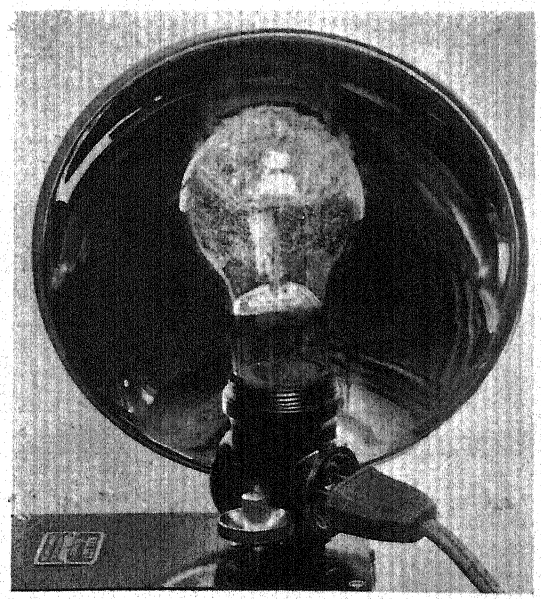


FIG. 6. SIMPLE MULTIPLE FLASH UNIT. A common inexpensive three-way electric plug may be inserted in the bulb socket of any synchronizer and convert it into a multiple flash unit. Here is one mounted on the Kalart Micromatic

MAKING THE MULTIFLASH PICTURE

Multiple flash photography with a synchronizer is even less complicated than the first method outlined. As the function of synchronization is to record action, a moving subject may be selected. The most animated of all subjects, and one of the most interesting, is a child. His chubby little face reflects his every emotion and his fragile arms and hands are never still—thus an ideal model for the first synchro-multiple flash picture.

The simplest synchronizing equipment will do very well. A three-way outlet is inserted into the synchronizer bulb socket, as shown in Figure 6; a small flashbulb is in the top outlet; the lamp cord is inserted in one of the side outlets; and a flashbulb is substituted for the regular bulb in the lamp. The photographer must be sure, however, *that all contact points are clean and snug fitting*. This is important. If any points are corroded, they should be filed and cleaned.

In order to secure action, the photographer may place a new, shiny toy approximately six feet from the camera to one side and slightly behind the auxiliary lamp. With this lighting arrangement, the exposure will be about f/11 at 1/200 second with Verichrome or panchromatic film. The child is then called and the suggestion given that he find the gift. As he or she discovers the object and turns to show mother or the photographer, the model will have action and expression both—the right moment to release the shutter.

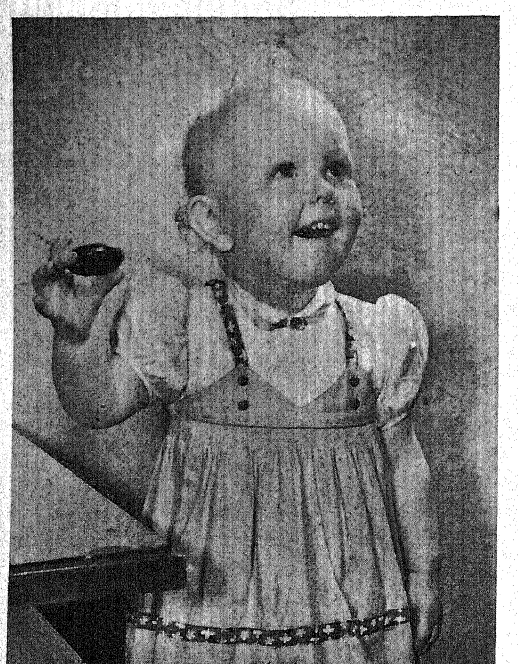


FIG. 7. ACTION PHOTO AT HOME. With an auxiliary bulb in a floor lamp 3 feet to the right and above the child's head and one at the camera, this synchroflash photo was taken. DATA: Speed Graphic, medium pan film, 1/200 second, f/11

If the multiflash equipment has been properly placed and the synchronizer fired at the right instant, the result will be similar to Figure 7. The 1/200 second shutter speed has stopped the action and reproduced the expression, while the floor lamp (to the right and above) has given the youngster a halo, increased the depth of the picture, and brought out the modeling in its face. With single flash, such an informal study would have little depth, a black shadow on the background, more exposure on the part of the face nearest the camera, and few if any highlights.

LIGHT PLACEMENT

The most important phase of multiple flash photography is the arrangement of the auxiliary flash lamps. Not only does the placement of tandem lights determine the quality, balance, and effect of multiflash, but also governs the amount of exposure required for each set-up.

Essentials of proper light placement may be learned by first using photofloods, and, when the correct effect is obtained, substituting flashbulbs of corresponding light intensity. By "corresponding light intensity" is meant that equal sized flashbulbs should be substituted. However, if small and large floods are employed, relatively small and large flashbulbs should be used.

"Pilot lighting," as this flash-for-flood substitution method is called, can be accomplished simply and easily. After the photographer has arranged the photofloods and noted the effect and balance contribution of each in the groundglass, all connections are transferred from the house current to the synchronizer. The photoflood bulbs are then removed and the photoflash substituted. Again all connections must be checked frequently for contact and snugness.

From this method of substituting flashbulbs for photofloods a number of general multiple flash rules can be learned:

1. *Usually, any lighting possible with photofloods is feasible with photoflash.*

2. *Either the flashbulb on the camera or any one of the auxiliary flashes may be employed as the main or key light.* If the tandem light is the principal source of illumination, a flashbulb is usually placed at the camera to provide a balance of light—that is, to fill in and cut shadows, making them "transparent."

3. Generally, *auxiliary flash lights should be placed only where light might be expected to originate.* For natural effects, tandem flash reflectors should be placed where windows, house lamps, ceiling lights, etc. might be or are located.

4. The final "must" of multiflash is that, in ordinary use, *all flashbulbs should normally be above the level of the lens.* If bulbs are placed below the lens, an unnatural, unflattering result is certain. This type of beneath-the-lens illumination is desirable only when highly dramatic effects—to express horror, intense hatred, and the like—are wanted. Figure 17 is an example of beneath-the-lens illumination.

As progress is made in the use of multiple flash, the substitution method of flash-for-flood can be eliminated and experience will tell the photographer where to place the flashbulbs and what size to use for the effect he desires. The photographer can be aided in arranging flashbulbs without the use of photofloods by sighting along each reflector from behind and making a mental note of where each will illuminate the subject. Some have made ingenious flood and flash reflector combinations permitting easy switch-over from photoflood to flashbulb.

Extreme care must be taken to avoid shadows where they are not desired in the final print. This is the function of the fill-in bulb. On the other hand, the fill-in flash should not be so intense that the highlight details are eradicated. This can be controlled by varying the distance of the fill-in bulb from the subject, or by changing the size of the bulb. For example, a large photoflash may be used in the auxiliary and a small flashbulb in the synchronizer reflector.

EXPOSURE

The determination of exposure with multiple flash lighting is at first quite a problem. However, as in single flash, *the exposure is determined exactly and precisely by the size of the main or "key" bulb and its distance from the subject.* The term "main" or "key" light is that bulb which provides the most intense illumination. Whether the bulb on the camera or one of the auxiliary lights is the main source, it is only this one bulb that need be considered in calculating the exposure. If flashbulbs of equal size are used in both the synchronizer and tandem reflectors, the bulb closest to the subject is the main light and governs the exposure calculation. Changing the distance of the main light source from the subject always changes the exposure.

Once the distance from the main light source to the subject has been measured mentally, the remainder of the exposure data can be secured from flash exposure tables distributed by the various flashbulb manufacturers (see page 1795). The flash tables list the correct aperture or f-number for varying distances, speeds, and types of film. Merely look up the distance from the main light source to the subject under the division devoted to the film and bulb size with which the picture is to be made, and the aperture at open flash and various instantaneous speeds will be given.

For quick reference, many photographers glue that portion of the table which lists the exposures for their type films to the back of their synchronizer reflectors. Thus the chart is always at hand whether one is using single or multiple flash technics and all guesswork is eliminated from flash photography exposure times.

Exposure in multiflash photography is vitally effected by a number of other factors in addition to lens aperture, film speed, shutter setting, bulb size, and the distance from the main light to the subject. The absence or presence, color, and distance of walls and ceilings may halve or quadruple the exposure. Pictures taken inside with light colored walls and a low ceiling require considerably less exposure than photographs taken in dark colored rooms with high ceilings, or outdoor photos at night.



FIG. 8. ACCENTING WITH MULTIFLASH. A tandem flash reflector placed above and 6 feet to the left of the children gave lighting which concentrates all attention on the children. DATA: Speed Graphic, fast press pan film, 1/200 second, f/22, Wabash Press 40 bulbs

Many a photoflash exposure has been ruined by the presence of excessive smoke or ice vapor with which the photographer has not reckoned in calculating his aperture and speed. As much as three and four times more exposure must be given in night clubs, auditoriums, and other locales where the smoke is excessive. Exposure allowance must also be made when photographing hockey and skating in interior ice rinks.

Occasionally, to produce a beautiful diffused lighting, the photographer may cover one or more flashbulbs with a handkerchief or cheese cloth. The cloth cuts down light from 30 to 60 per cent, depending on its density, and exposures must be increased accordingly.

Still another factor, which may worry some color enthusiasts who use blue flashbulbs occasionally for black and white photography, is the effective difference in the color of the flashbulb glass. Carefully conducted experiments indicate that no change in exposure is necessary when using the blue bulbs for black and white photography. Simply calculate the exposure as if the blue bulbs were the regular type of the same number.

A final exposure problem which may face the novice multiflasher is the determination of lens speed and aperture when two bulbs are used at or very near the camera. Generally, the rule is that two bulbs produce twice as much light as one, if they are both fired by current directly from the batteries and not by heat from one bulb to the next. It does not follow that two bulbs will carry twice as far as one, hence the exposure should be halved only for comparatively close work.

MULTIFLASH IN THE HOME

Freedom from elaborate and expensive lighting equipment is one of the greatest advantages of multiple flash photography. The amateur does not require a studio filled with powerful lights to secure well lighted, action-filled pictures of his youngster, wife, or family, for now he can convert any part of his home into an efficient studio with multiflash.

By merely substituting flashbulbs in regular house lamps and plugging the lamp cord into his synchronizer, the novice photographer can secure a natural reproduction of the home setting. In addition, he may employ tandem flash reflectors to improve close-ups of family members, to illuminate several rooms at one time, and to control backgrounds accurately.

Emphasizing the principal subject is a general rule of composition easily applied in home photography by the use of multiple flash. To accentuate any particular subject (set it off from its surroundings to center the interest), merely concentrate the light upon that portion of the subject by means of a tandem reflector and leave the synchronizer light source to fill in the shadows. For example, if the face and expression of the subject is the feature, direct the tandem reflector upon the head and shoulders; if the principal interest is centered about two or more persons in a room, as in Figure 8, the interest can be directed to the group by concentrating the tandem flash on it. The camera light source will provide sufficient detail to tell the rest of the story.

The rule, then, for multiflash photography at home is to place auxiliary flash reflectors

(1) where they will emphasize the center of interest, (2) where light can be expected to naturally originate. In short, place lights where they will be most beneficial and most natural.

Texture and depth, two requisites of a good picture, are made possible by the use of top- and sidelighting, placing auxiliary lights above or to one side of the subject. This arrangement produces modulation of surfaces and roundness, while backlighting is frequently employed to make the subject stand out from the background, giving a feeling of third dimension or depth to the print. Backlighting is obtained by directing the tandem flash toward the subject from behind. Care must be taken to prevent any back light from striking the camera lens.

Background Control. Light, shaded, or completely black backgrounds can be obtained by varying the placement of auxiliary flashbulbs. If the background is to be well lighted, one or two lights should be placed behind the subject and directed toward the background; if a partially lighted background is desired, a strong front lighting must be employed near the camera and only a small bulb used for the background. However, if the background is to be dark, tandem flash reflectors are used to concentrate light only on the subject and no on-the-camera illumination is employed. By this arrangement, light reaches only the subject and the background receives no illumination, hence it appears as though black.

An interesting example of background control and emphasis with light is Figure 9, an informal multiflash picture of a colored lad arduously practicing his piano lesson. Concentration of light upon the center of interest—both face and hands—was obtained by using a tandem flash in front of and above the youthful pianist, highlighting both the taut fingers and solemn face. To set off the features of the subject from an otherwise dark background, a second tandem bulb was placed behind the subject, directed toward the wall, casting the head and shoulders into silhouette and effectively supplying a sense of depth in the print.

Multiple flash picture ideas for home use are practically inexhaustible—the family youngster in his bath (try an extra bulb to one side and slightly above and see how "wet" the water drops appear and how many glimmering highlights are reflected from his moist features) . . . Dad reading the newspaper at his desk with the study lamp casting long, interesting shadows (substitute a flash-

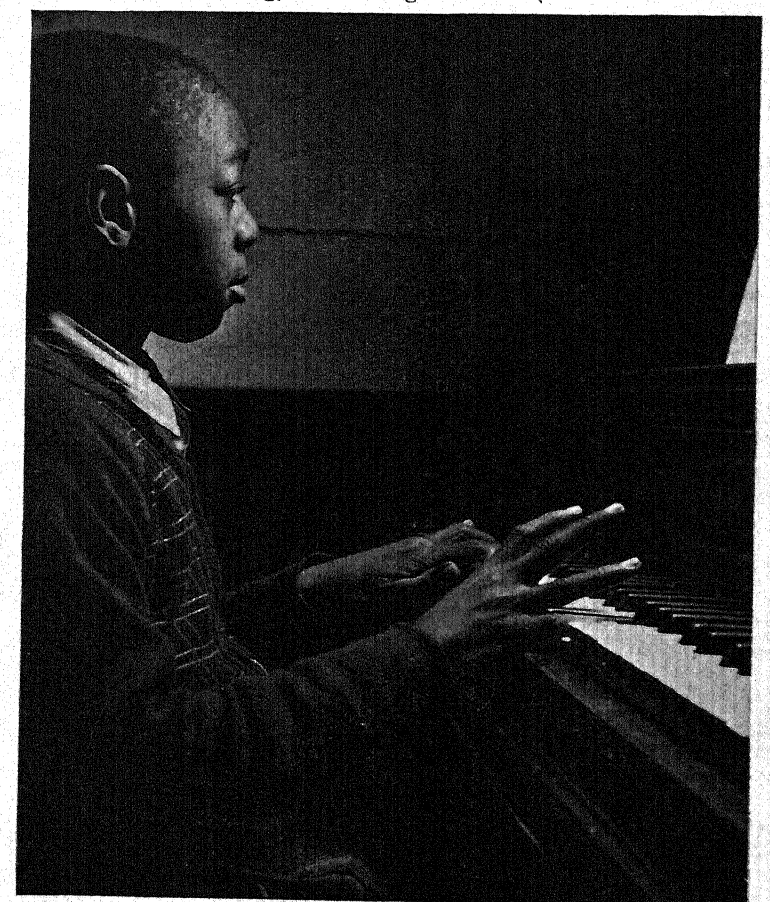


FIG. 9. MUSIC LESSON. For this striking shot, a bulb was used on an extension directly in front of the boy and another behind him, facing the wall. There was no flash on the camera. DATA: 4 x 5 Speed Graphic, fast press pan film, 1/200 second, f/22, Wabash Press 40 bulb at right, No. 1 Superflash at back

bulb in the desk lamp and record those shaddows and his expressions as he reads) . . . simulate firelight by placing a tandem flash in the fireplace (a large bulb between the andirons and a small bulb in the camera reflector will do the trick) . . . give real depth to an interior view by placing the camera with a small flash in one room and shooting through the doorway into another (light the second room with a tandem flash above the doorway) . . . making living room silhouettes by placing the tandem bulbs behind the subjects and directed toward the wallpaper . . . shooting into the house through the windows, the interior lighted by flash . . . any position for simulating various artificial light sources.

MULTIFLASH AND PORTRAITURE

In flash portraiture the photographer must first decide whether the main source of light is to be the bulb on the camera or one of the auxiliary flashes. Excellent results are obtainable by using the camera bulb as the key light and employing one of the auxiliary lamps as a side, back, or top light.

Another interesting variation, giving life and interest to the portrait, is the use of one auxiliary lamp as the main or key light and the employment of the camera bulb to fill in the shadows and provide balance. When the auxiliary lamp is placed almost anywhere above and in front of the subject, character-revealing detail will result. However, in the more formal science of portraiture, several definite light positions have been found to be most advantageous and pleasing.

Practically all of the regulation lighting arrangements—the 45 degree, the Rembrandt, profile lighting, "glamor" lighting, etc.—

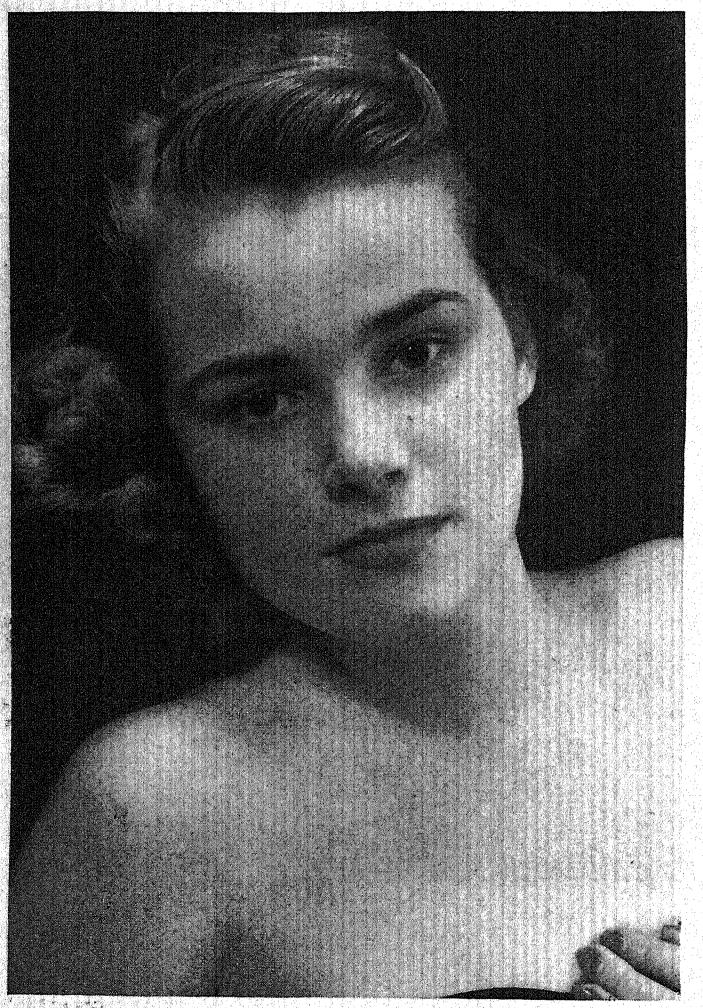


FIG. 10. AUGMENTED 45-DEGREE LIGHTING. For portraiture with multiflash, an arrangement like this is always good. A flashbulb was above and to the right and another at the camera, with toplighting provided by a similar bulb directly over the model's head. A similar arrangement is pictured in Figure 12. DATA: Speed Graphic, fast pan press film, 1/200 second, f/32, Press 40 bulbs

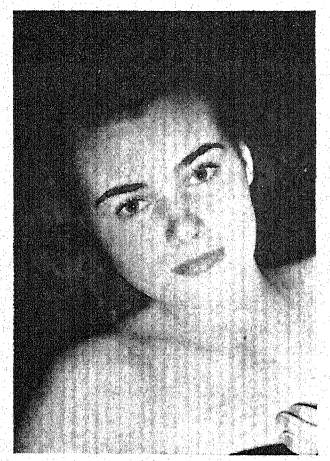


FIG. 11. FLAT LIGHTING. Contrast this picture, made with a single bulb at the camera, with the multiflash lighting of Figure 10. DATA: Speed Graphic, fast pan press film, 1/200 second, f/32, Press 40 bulb

can be produced with multiflash equipment without the necessity of establishing electrical connection with the house current. As portraiture is a highly specialized field of photography, only the more general types can be discussed in an article of this nature.

45-Degree Lighting. Probably the most easily duplicated, the 45-degree light, is produced by simply holding the tandem flash above, to the right or left, and slightly in front of the subject. If properly placed, the auxiliary flash will cast a shadow at about 45 degrees with the plane of the nose. The on-the-camera reflector in this type of lighting provides the balance necessary. The 45-degree lighting, as illustrated in Figure 10, is

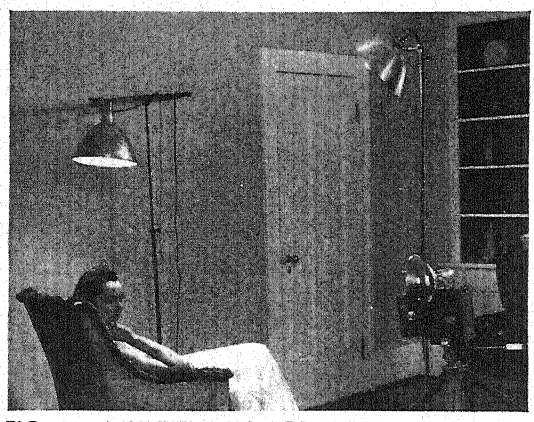


FIG. 12. MULTIFLASH ARRANGEMENT. Here is a lighting set-up for home portraiture which will give the effect shown in Figure 10



FIG. 13. SEMI-PROFILE. The main light is at the extreme right, with the fill-in bulb above the camera and diffused by a handkerchief. The arrangement is pictured in Figure 15. DATA: Speed Graphic, fast press pan film, 1/200 second, f/32, Press 40 Superflash bulbs



FIG. 14. SINGLE-FLASH SEMI-PROFILE. Note the black background shadow, the flattened features, and the lifeless eyes and see Figure 13 for the improvement by multiflash. DATA: Speed Graphic, fast press pan film, 1/200 second, f/32, Press 40 Superflash bulb

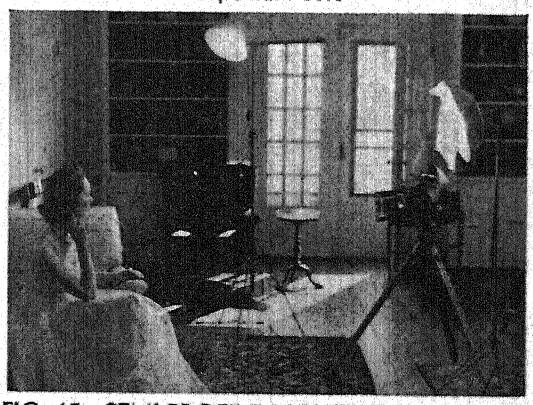


FIG. 15. SEMI-PROFILE LIGHTING ARRANGEMENT. The set-up for the lighting of Figure 13 is shown. Notice the handkerchief over the camera light to give softness



FIG. 16. PROFILE LIGHTING. This bridal portrait was made with multiflash—a bulb at the extreme left, in front and above the subject, and one at the camera. DATA: Speed Graphic, fast press pan film, 1/200 second, f/22, Press 40 bulbs

augmented and improved by the addition of a top light directly above the subject's head, highlighting the hair still more and removing undesired shadows from the light background. Contrast Figure 10 with Figure 11, a single flash exposure of the same subject. The location of light sources, camera, and a similar subject is given in Figure 12.

Half-length, Semi-profile. The age-old Rembrandt style of illumination is one of the simplest to use with multiflash. The main or stronger light source is placed on the extreme right or left of the camera and the subject turned partially toward the key source. The synchronizer bulb should be held about two feet above the camera.

In Figure 13 the key light has set off the subject from the background, given roundness and depth to the features, and provided modulation and skin tone. Again contrast this type with the single flash study, Figure 14. Softness was added to the multiflash portrait by covering the at-the-camera flash with a handkerchief as pictured in Figure 15.

Full Profile Lighting. The placement of an auxiliary flash directly in front of and above the subject's face (therefore, to the extreme right or left of the camera) affords a pleasant lighting for profile portraiture. This lighting arrangement (Fig. 16), with a bulb placed at the camera, is frequently employed to eliminate background shadows and to bring out the contours of the clothing.

SPECIAL PORTRAIT LIGHTING

An interesting variation in flash portraiture may be obtained by using Hollywood's famed style of backlighting. A deep reflector is placed behind and above the subject and directed toward the back of the head, glamorously highlighting the hair and setting the subject off from the background. The backlight can be used in conjunction with practically any type of front or sidelighting. However, care must be taken to prevent any light from striking the camera lens directly.

In many instances, it is not desirable to use a light at the camera because broad faces are made still wider by such flat lighting. In this case, tandem flashbulbs may be placed both to the right and the left of the

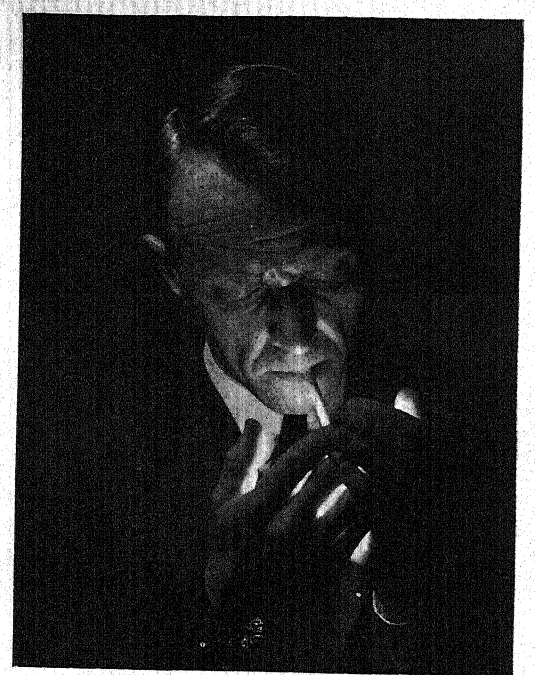


FIG. 17. DRAMATIC LIGHTING. The effect of a match was achieved by concealing a small SM flashbulb in the model's hand, while the other light was a 16A above and to the left. Flashed by combined Victor Speed-O-Matic and SM synchronizers. DATA: Medium pan film, 1/200 second, f/22
Photo from James H. Smith & Sons



FIG. 18. CHOIR. This group was effectively lighted by two No. 2 Superflash bulbs directly in front of the choristers. The tandem reflectors were held at arm's length by assistants and no light was located at the camera, thus silhouetting the cross and palms. DATA: Speed Graphic, fast press pan film, 1/200 second, f/16

camera, and balance achieved by locating one of the bulbs slightly nearer the subject. Both lamps should be well above the level of the lens and the subject's head.

Frequently advantageous in drama photography, photo-journalism, and salon work is the highly dramatic and eerie atmosphere created by purely beneath-the-lens illumination. Tandem flash reflectors directed upward toward the subject cast long, dark shadows which are tremendously effective in dramatic photography. Figure 17 illustrates unusual auxiliary flashlighting, with a bulb concealed in the model's hand and a very weak flash directed at the top of his head.

Background control in portraiture can be accomplished by directing flashbulbs toward the background, as in home flash photography. A pleasant and interest-centering effect in flash portraiture may be obtained by placing a flashbulb, without the reflector, between the subject and a plain back surface. A gradual modulation of white at the center to gray at the corners is achieved by this multiflash treatment.

MULTIFLASHING GROUPS

Groups are probably the most frequent subjects of amateur and professional photographers and cause the most headaches for single flash cameramen. For one thing, with single flash lighting, those nearest the camera are bound to get more lighting and exposure than those in the rear and a larger aperture must be used in order to accommodate the reduced light on those farthest from the camera. This results in "burning up" the foreground and in less depth of field.

Single flash lighting especially handicaps the photographer when taking a group which extends in a narrow line from the front of the lens almost to infinity, such as at a long table. Here it is virtually impossible, even with the latitude of present-day films and

with considerable dodging, to obtain detail and sharpness in both foreground and background.

Multiple flash lighting can be utilized to solve all these group lighting problems and further to add beauty and human interest to a prosaic assembly of persons. Placing auxiliary flash reflectors at intervals above or to the side of groups permits a much smaller aperture, because the foreground and the background are evenly illuminated. The subject immediately in front of the lens requires no less exposure than those farthest away.

To illuminate evenly a small group of persons, numbering up to 25 or 30, only two or three bulbs are required. For broad group lighting, the tandem flashes may be placed about 15 feet to the right and to the left of the camera. These auxiliary lamps, in combination with the at-the-camera bulb, will provide ample illumination for a wide spread of persons and are particularly useful in outdoor night photography.

The knotty problem of photographing a long table extending away from the camera can be best solved by placing auxiliary flashbulbs every 20 feet, directed away from the camera down the group. These should be located as high above the group as possible. With this method the camera aperture can be extremely small and a great depth of field obtained.

The balancing effect of two bulbs in group work is illustrated in Figure 18, an action picture of an Easter choir. Multiple flash was employed in making this group study for two reasons: first, to obtain an even lighting on the choristers; second, to silhouette the cross and palm, thus adding an artistic touch to a feature news illustration. Even illumination was achieved by having a by-

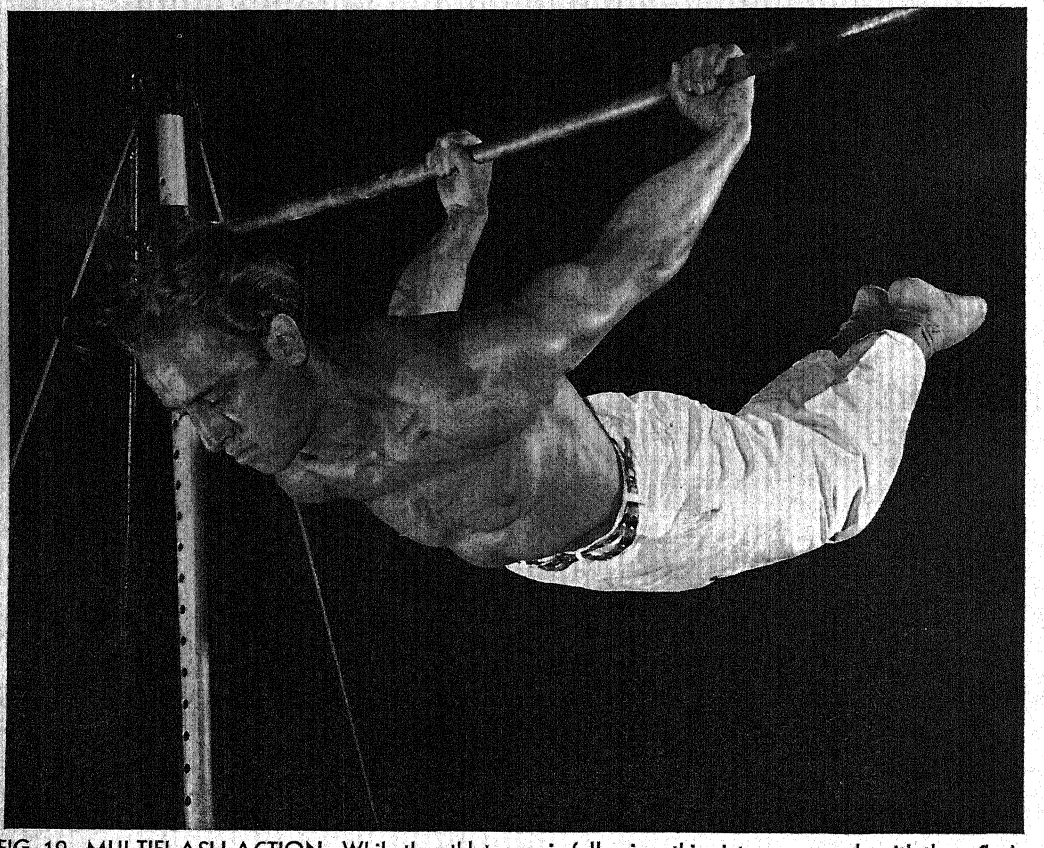


FIG. 19. MULTIFLASH ACTION. While the athlete was in full swing, this picture was made with three flashbulbs. Notice how the subject stands out from the background in this press feature shot. DATA: 4 x 5 Speed Graphic, fast press pan film, 1/400 second, f/11
PM photo, Dale Rooks

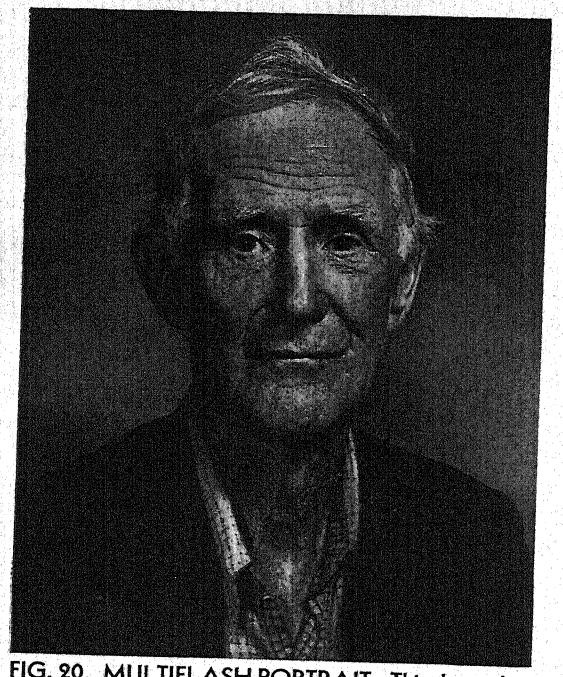


FIG. 20. MULTIFLASH PORTRAIT. This shows that multiflash can make even a hurried news photograph look like a carefully deliberated portrait. DATA: Speed Graphic, fast press pan film, 1/200 second, f/16, No. 1 Superflash at camera, Press 40 above and to left

stander hold two medium-sized bulbs directly in front of and above the choir, each reflector supported at arms length with mop sticks. No bulb was used at the camera, thus throwing the cross and palm branches into a silhouette. For larger groups, see article on *Banquet Photography*, page 387.

Human interest, drama, and beauty can be incorporated in an otherwise uninteresting group photo by lighting-for-emphasis, as discussed under the home uses of multiflash. Perhaps in the majority of cases a single flash might record a group of persons just as they appear, but the addition of multiple lighting gives the picture that "punch" which makes the difference between the commonplace and the unusual.

A picture may be enhanced by placing part of the group in silhouette or in deep shadow. Then, too, much of the squalor and undesirability of certain surroundings may be eliminated by controlled multiple flash lighting. No photographer can tell another just exactly when and where the "artistic" should be added to a picture. It is purely a matter of personal experience and feeling.

PHOTO-JOURNALISM AND MULTIPLE FLASH

Historians of journalistic illustration have noted a definite and growing demand for top quality in news pictures. Formerly, if a press photographer secured a fairly sharp picture, he was considered a good photographer. Today, however, with the advent of perfected flashbulbs, fast films, fine grain developers, the general usage of filters, and complicated lighting set-ups, managing and city editors have raised their standards of news picture value to the skies and are demanding pictures combining sharpness, action, quality lighting, and perfect darkroom treatment. In reply to this demand, multiple flash photography is being used by more press photographers every day. It has proved one of the most valuable aids to good reproduction in recent years.

With multiple flash lighting, the press photographer can make his subject fairly leap out of the background (Fig. 19), can eliminate much artificial retouching, can reproduce the whole story of a given news



FIG. 21. FEATURE PHOTO. This scene of a small poor boy and his pets was illuminated by bulbs on the camera and also just inside the tent. The second light brought out the boy's black coat and hat against a dark background. DATA: Speed Graphic, fast press pan film, 1/200 second, f/16, No. 2 Superflash bulbs



FIG. 22. DISTRACTING BACKGROUND. A frequent problem is a background which must be retouched out. At the left is such a photo, with wild wallpaper taking attention from the girl. At the right is the same girl in the same pose, but with a tandem flash directed against the undesired background and burning it out. DATA (photo at right): 3¼ x 4¼ Speed Graphic, fast press pan film, 1/50 second, f/5.6, Press 40 without reflector on camera, No. 3A Superflash without reflector on wall

situation by accurately duplicating the lighting at the scene of the news, and can also vastly improve many of his feature and rotogravure prints.

Portraiture is one of the most frequent assignments given to news photographers and photo-journalists. For crisp reproductions, the features of the face must be in sharp contrast. The handiest and most speedy method of accomplishing this is holding the auxiliary flash in the left hand and releasing the synchronizer with the right. By combining the single, hand-held, tandem flash and the bulb in the synchronizer, the majority of regular portrait lightings can be duplicated with a minimum of time and effort. The kindly face of the aged gentleman in Figure 20 was recorded for newspaper use in this manner and the print made an excellent engraving. Note how the undesirable background shadow, which always attends single flash pictures, has been removed and how even the minutest details of the facial features are emphasized.

The most valuable use of multi-synchronization to the press photographer is the elimination of retouching and the control of backgrounds. The main difficulty in all newspaper art is to make subjects stand out from their surroundings, whether group shots or portraits. This is particularly noticeable in winter when men wear dark suits and are photographed against black backgrounds.

The easiest way to make a subject stand out is by placing an auxiliary lamp behind the subject, thus highlighting the edges of the figure. This gives a more natural effect than retouching with white paint and also eliminates the dark outline shadow formerly on the background. Such an edge light was provided by multiflash technic in Figure 21, a news feature shot of a son of poverty sitting with his only toys in the door of his tent home. The black coat and helmet of the lad would have merged with the dark interior of the tent by using single flash. To show a clear outline of the figure, an auxiliary lamp was directed toward the back of the head from within the tent. As is apparent, the extra bulb highlighted the dark aviator cap, shoulders, and arms of the subject.

(Continued on page 2361)

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